P2219, 1902

ROSS' CELEBRATED LENSES

ZEISS' AND GOERZ' ANASTIGMATS.

AN ABSOLUTELY UNRIVALLED SELECTION
FOR EVERY DEPARTMENT OF PHOTOGRAPHY.

Index to Contents, pages 1135 to 1142.
Index to Advertisements, pages 1199 to 1202.

1902.

JANUARY.

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	..
..	..	..	..	..	..	..

FEBRUARY.

S	M	T	W	T	F	S
..	..	..	..	..	..	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	..
..	..	..	..	..	..	..

MARCH.

S	M	T	W	T	F	S
..	..	..	..	..	..	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	..	..	..	..	..

APRIL.

S	M	T	W	T	F	S
..	..	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	..	..	..
..	..	..	..	..	..	..

MAY.

S	M	T	W	T	F	S
..	..	..	..	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
..	..	..	..	..	..	..

JUNE.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	..	..	..	..	..
..	..	..	..	..	..	..

JULY.

S	M	T	W	T	F	S
..	..	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	..	..
..	..	..	..	..	..	..

AUGUST.

S	M	T	W	T	F	S
..	..	..	..	..	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	..	..	..	..	..	..

SEPTEMBER.

S	M	T	W	T	F	S
..	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	..	..	..	..
..	..	..	..	..	..	..

OCTOBER.

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	..
..	..	..	..	..	..	..

NOVEMBER.

S	M	T	W	T	F	S
..	..	..	..	..	..	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	..	..	..	..	..	..

DECEMBER.

S	M	T	W	T	F	S
..	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	..	..	..
..	..	..	..	..	..	..

POSTAL AND TELEGRAPHIC ADDRESSES,
1235 to 1244.

THE 'UNAR' LENSES.

AN IMPORTANT NEW SERIES
OF ROSS-ZEISS ANASTIGMATS.

See pages 35 to 98.

WRATTEN'S 'LONDON' PLATES

Are ordered by the leading Governments for all Photographic work in the Tropics.

JANUARY.

D. M.	D. W.	REMARKABLE EVENTS.	SUN. Rises. H.	M.	SUN. Sets. H.	M.	MOON. Rises. Morn.	MOON. Sets. Morn.
1	W	☾ 4.8 A.	8	8	3	59	Morn	11 11
2	Th		8	8	4	0	0 51	11 34
3	F	Prof. J. W. Draper d. 1882	8	8	4	1	1 55	After
4	S		8	8	4	2	2 58	0 28
5	S	2nd Sunday after Christmas	8	8	4	3	3 59	1 1
6	M	Epiphany	8	8	4	4	4 56	1 40
7	Tu	Daguerreotype com. to Acad. of Sc.	8	7	4	5	5 49	2 24
8	W	[(Paris), 1839	8	7	4	7	6 37	3 17
9	Th	● 9.15 A.	8	6	4	8	7 20	4 16
10	F		8	6	4	10	7 56	5 20
11	S		8	5	4	11	8 27	6 27
12	S	1st Sunday after Epiphany	8	5	4	12	8 54	7 37
13	M	William Bedford d. 1893	8	4	4	13	9 20	8 49
14	Tu		8	3	4	15	9 44	10 2
15	W	G. W. Simpson d. 1880	8	2	4	16	10 8	11 16
16	Th		8	2	4	18	10 34	Morn
17	F	☽ 6.38 M.	8	1	4	20	11 2	0 30
18	S	E. Lacan d. 1879. Rejlander d. 1875	8	0	4	22	11 36	1 45
19	S	2nd Sunday after Epiphany	7	59	4	23	After	3 0
20	M	Photo. Soc. of Lond. f. 1853	7	58	4	25	1 6	4 12
21	Tu	Fox Talbot b. 1800	7	57	4	26	2 7	5 17
22	W	Sir W. Newton d. 1869	7	56	4	28	3 15	6 11
23	Th		7	55	4	30	4 29	6 55
24	F	○ 0.6 M.	7	54	4	32	5 45	7 32
25	S		7	52	4	33	7 1	8 3
26	S	Septuagesima Sunday	7	51	4	35	8 14	8 29
27	M	[1863	7	50	4	37	9 24	8 53
28	Tu	Photo-sculpture pat. by Willème,	7	49	4	39	10 33	9 16
29	W	[Royal Soc. 1839	7	47	4	40	11 40	9 39
30	Th	Fox Talbot's first communication to	7	46	4	42	Morn	10 3
31	F	☾ 1.9 A.	7	44	4	44	0 44	10 30

RESIDUES

Reduce every description of PHOTOGRAPHIC RESIDUES.

Consignments and Remittances punctually attended to.

J., J. J. & T. G. BLUNDELL, Gold, Silver, & Platinum Refiners & Dealers,
199 (formerly 162) WARDOUR STREET, LONDON, W.

THE THORNTON-PICKARD 'AUTOMAN' HAND CAMERAS.
SEE PAGES 1266 to 1268
ONE TOUCH opens the 'Automan' Cameras, and automatically brings the lens into CORRECT POSITION.

JANUARY.

D. M.	D. W.	MEMORANDA.
1	W	
2	Th	*For* Meetings of Societies, *see pp.* 623-675.
3	F	
4	S	
5	**S**	
6	M	
7	Tu	
8	W	
9	Th	
10	F	
11	S	
12	**S**	
13	M	
14	Tu	
15	W	
16	Th	
17	F	
18	S	
19	**S**	
20	M	
21	Tu	
22	W	
23	Th	
24	F	
25	S	
26	**S**	
27	M	
28	Tu	
29	W	
30	Th	
31	F	

RESIDUES
Nitrate of Silver & Chloride of Gold (best quality only).
MELTING and ASSAYING done for the Trade.
J., J. J. & T. G. BLUNDELL, Gold, Silver, & Platinum Refiners & Dealers,
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The 'LONDON' PLATES
ARE THE BEST
CLIMATE RESISTANTS

FEBRUARY.

D. M.	D. W.	Remarkable Events.	Sun. Rises. H. M.	Sun. Sets. H. M.	Moon. Rises. Morn.	Moon. Sets. Morn.
1	S		7 42	4 46	1 45	11 1
2	S	Sexagesima Sunday	7 41	4 48	2 45	11 37
3	M		7 39	4 49	3 40	After
4	Tu		7 38	4 51	4 31	1 8
5	W		7 36	4 53	5 15	2 5
6	Th		7 35	4 55	5 54	3 7
7	F		7 33	4 57	6 28	4 14
8	S	Calotype Process pat. 1841. ● 1.22 A.	7 31	4 59	6 58	5 23
9	S	Quinquagesima Sunday	7 29	5 0	7 24	6 35
10	M	Sir David Brewster d. 1868	7 28	5 2	7 49	7 49
11	Tu		7 26	5 4	8 13	9 4
12	W		7 24	5 6	8 39	10 20
13	Th	Leon Foucault d. 1868	7 22	5 8	9 7	11 36
14	F	St. Valentine	7 20	5 10	9 39	Morn
15	S	☽ 2.57 A.	7 18	5 11	10 18	0 50
16	S	1st Sunday in Lent	7 16	5 13	11 4	2 1
17	M	[portraiture) pat. 1857	7 14	5 15	11 58	3 6
18	Tu	Moule's Photogen (artificial light for	7 12	5 17	After	4 2
19	W	[1855	7 10	5 19	2 11	4 49
20	Th	Poitevin's p. of Helioplastie pub.	7 8	5 21	3 24	5 28
21	F	H. P. Robinson d. 1901, aged 71	7 6	5 22	4 38	6 1
22	S	○ 1.3 A.	7 4	5 24	5 52	6 30
23	S	2nd Sunday in Lent	7 2	5 26	7 4	6 55
24	M		7 0	5 28	8 14	7 19
25	Tu		6 58	5 29	9 21	7 42
26	W	Senefelder d. 1834. Padre Secchi d.	6 56	5 31	10 27	8 6
27	Th	[1876. Arago b. 1786	6 54	5 33	11 31	8 32
28	F		6 52	5 35	Morn	9 1

RESIDUES
COMPLETE RECOVERY of GOLD, SILVER, AND PLATINUM guaranteed, and Full Market Value allowed.
J., J. J. & T. G. BLUNDELL, Gold and Silver Refiners and Melters,
199 (formerly 162) WARDOUR STREET, LONDON, W.

THE
THORNTON-PICKARD
HAND CAMERAS
The 'ROTATOR' Magazine Camera for 12 ¼-plates.
The 'GRAPHTON' Hand Camera for 3 double plate-holders.
SEE PAGES 1269 and 1270

FEBRUARY.

D. M.	D. W.	MEMORANDA.
1	S	*For* Meetings of Societies, *see pp.* 623–675.
2	S	
3	M	
4	Tu	
5	W	
6	Th	
7	F	
8	S	
9	S	
10	M	
11	Tu	
12	W	
13	Th	
14	F	
15	S	
16	S	
17	M	
18	Tu	
19	W	
20	Th	
21	F	
22	S	
23	S	
24	M	
25	Tu	
26	W	
27	Th	
28	F	

BLAIR FILMS AND PLATES
The EUROPEAN BLAIR CAMERA CO., Ltd., Foots' Cray, KENT.
[*See following pages.*

The 'LONDON' PLATES

Coated on Thin and Accurately
Cut Glass for
MINIATURE & SHEATH CAMERAS.

MARCH.

D. M.	D. W.	Remarkable Events.	Sun. Rises. H. M.	Sun. Sets. H. M.	Moon. Rises. Morn.	Moon. Sets. Morn.
1	S		6 50	5 36	0 32	9 35
2	S	3rd Sunday in Lent. ☾ 10.39 M.	6 48	5 38	1 28	10 16
3	M		6 46	5 40	2 21	11 1
4	Tu	Poitevin d. 1882	6 44	5 42	3 7	11 53
5	W	La Place d. 1827. J. Albert b. 1825	6 41	5 44	3 49	After
6	Th	Fraunhofer b. 1787	6 39	5 46	4 25	1 56
7	F	J.N. Niepce b. 1765. Herschel b. 1792	6 37	5 47	4 56	3 5
8	S	[d. 1893	6 35	5 49	5 24	4 16
9	S	4th Sun. in Lent. G. W. Wilson	6 32	5 51	5 51	5 29
10	M	● 2.50 M.	6 30	5 53	6 16	6 45
11	Tu	St. Claire Deville b. 1818	6 28	5 54	6 42	8 2
12	W		6 26	5 56	7 10	9 20
13	Th		6 23	6 57	7 42	10 37
14	F	Herschel int. hypo for fixing, 1839	6 21	5 59	8 18	11 51
15	S		6 19	6 1	9 1	Morn
16	S	5th Sunday in Lent. ☽ 10 13 A.	6 17	6 3	9 52	0 59
17	M		6 14	6 4	10 55	1 57
18	Tu		6 12	6 6	After	2 47
19	W	Thomas Sutton d. 1875	6 10	6 7	1 12	3 29
20	Th		6 8	6 9	2 24	4 2
21	F		6 5	6 11	3 36	4 31
22	S		6 3	6 13	4 47	4 57
23	S	Palm Sunday	6 1	6 14	5 57	5 21
24	M	Becquerel b. 1820. ○ 3.21 M.	5 59	6 16	7 6	5 44
25	Tu	Hermagis d. 1868	5 56	6 17	8 12	6 9
26	W		5 54	6 19	9 16	6 35
27	Th		5 52	6 21	10 18	7 3
28	F	Good Friday. La Place b. 1749	5 50	6 23	11 18	7 34
29	S		5 47	6 24	Morn	8 11
30	S	Easter Sunday	5 45	6 26	0 12	8 54
31	M		5 42	6 28	1 0	9 43

BLACK PAPER against *face* of Film, causing deterioration. PIGMENT NUMBERS transfer and appear in Negatives. [*See next page.*

THE THORNTON-PICKARD TIME & INST. SHUTTER FIRST & BEST. SEE PAGE 1254 See Reduced Prices.

MARCH.

D. M.	D. W.	MEMORANDA.
1	S	
2	S	*For* Meetings of Societies, *see pp.* 623-675.
3	M	
4	Tu	
5	W	
6	Th	
7	F	
8	S	
9	S	
10	M	
11	Tu	
12	W	
13	Th	
14	F	
15	S	
16	S	
17	M	
18	Tu	
19	W	
20	Th	
21	F	
22	S	
23	S	
24	M	
25	Tu	
26	W	
27	Th	
28	F	
29	S	
30	S	
31	M	

PURE WHITE PAPER against *face* of Film. No contamination. PERFORATED NUMBERS perfectly innocuous. [*See last page.*

WE COMMEND THE

LONDON 'SPEED' PLATE

to the attention of Photographers using Magnesium Lamps and other means of Artificial Lighting in the Studio.

APRIL.

D. M.	D. W.	Remarkable Events.	Sun. Rises. H. M.	Sun. Sets. H. M.	Moon. Rises. Morn.	Moon. Sets. Morn.
1	Tu	☾ 6.24 M.	5 40	6 29	1 43	10 39
2	W	First Sun Pho. by Fizeau and Fou-	5 38	6 31	2 20	11 40
3	Th	[cault, 1845. Morse d. 1872	5 36	6 33	2 53	After
4	F	[Niepce b. 1795	5 34	6 35	3 22	1 53
5	S	Rev. J. B. Reade b. 1801. Isid.	5 31	6 36	3 49	3 6
6	S	Low Sunday [Victor d. 1870	5 29	6 38	4 15	4 21
7	M	Voigtländer d. 1878. Niepce de St.	5 27	6 39	4 41	5 38
8	Tu	● 1.50 A. [1839	5 25	6 41	5 9	6 57
9	W	Fox Talbot's First Art. in *Athenæum*,	5 22	6 43	5 40	8 16
10	Th	Pouncy's Carb. Process pat. 1858.	5 20	6 45	6 15	9 34
11	F	[Clarence Fry d. 1897	5 18	6 46	6 58	10 47
12	S		5 16	6 48	7 49	11 50
13	S	2nd Sunday after Easter	5 13	6 49	8 48	Morn
14	M		5 11	6 51	9 55	0 44
15	Tu	☽ 5.26 M.	5 9	6 52	11 5	1 29
16	W		5 7	6 54	After	2 5
17	Th	Fargier's Carbon Process pat. 1861	5 5	6 56	1 27	2 34
18	F		5 3	6 58	2 37	3 1
19	S	Warren de la Rue d. 1889	5 0	6 59	3 46	3 26
20	S	3rd Sunday after Easter	4 58	7 1	4 53	3 49
21	M	Talbot's Photo.-etch. Proc. pat. 1858	4 56	7 2	6 0	4 13
22	Tu	○ 6.50 A.	4 54	7 4	7 5	4 38
23	W		4 52	7 6	8 8	5 4
24	Th	Celsius d. 1744	4 50	7 8	9 8	5 34
25	F	'Sun-blinds' pat. 1862	4 48	7 9	10 3	6 10
26	S	Adam Salomon d. 1881	4 46	7 11	10 54	6 51
27	S	4th Sunday after Easter	4 44	7 12	11 39	7 38
28	M	M. Carey Lea d. 1897	4 42	7 14	Morn	8 29
29	Tu		4 40	7 16	0 19	9 27
30	W	Colonel Stuart Wortley d. 1890. ☾ 10.58 A.	4 38	7 18	0 53	10 30

BLAIR

ROLLS, CARTRIDGES, and CUT SHEETS. [*See next page.*

THE THORNTON-PICKARD TIME EXPOSURE VALVE

SEE PAGE 1274

GIVES ACCURATE EXPOSURES of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 3 seconds AUTOMATICALLY.

APRIL.

D. M.	D. W.	MEMORANDA.
1	Tu	
2	W	*For* **Meetings of Societies**, *see pp.* 623–675.
3	Th	
4	F	
5	S	
6	**S**	
7	M	
8	Tu	
9	W	
10	Th	
11	F	
12	S	
13	**S**	
14	M	
15	Tu	
16	W	
17	Th	
18	F	
19	S	
20	**S**	
21	M	
22	Tu	
23	W	
24	Th	
25	F	
26	S	
27	**S**	
28	M	
29	Tu	
30	W	

FILMS

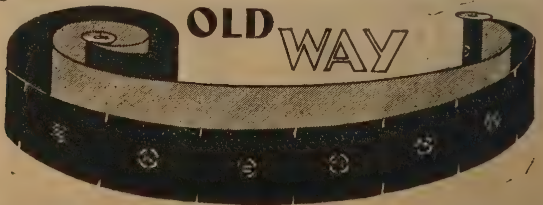
FOR ALL FILM CAMERAS AND CINEMATOGRAPHS. [*See next page.*

WRATTEN'S 'LONDON' PLATES.

Insist upon having the GENUINE 'LONDON' PLATES. If your Dealer does not stock them, write direct to the Makers.

MAY.

D. M.	D. W.	REMARKABLE EVENTS.	SUN. Rises. H. M.	SUN. Sets. H. M.	MOON. Rises. Morn.	MOON. Sets. Morn.
1	Th		4 36	7 19	1 22	11 36
2	F		4 35	7 21	1 49	After
3	S		4 33	7 22	2 15	1 57
4	S	Rogation Sun. Senebier b. 1742	4 31	7 24	2 40	3 11
5	M	J. W. Draper b. 1811	4 29	7 25	3 6	4 28
6	Tu	Humboldt d. 1859	4 27	7 27	3 34	5 48
7	W	● 10.45 A.	4 25	7 28	4 7	7 8
8	Th	Ascension Day. Peroxide of H.	4 24	7 30	4 47	8 25
9	F	[rec. for rem. of Hypo, 1866.	4 22	7 32	5 36	9 35
10	S	[P. Meagher d. 1897	4 20	7 34	6 33	10 36
11	S	S. aft. Ascen. Becquerel d. 1891	4 18	7 35	7 39	11 26
12	M	Sir John Herschel d. 1871. W. B.	4 17	7 37	8 50	Morn
13	Tu	J. v. Liebig b. 1803 [Bolton d. 1899	4 15	7 38	10 4	0 6
14	W	Fahrenheit b. 1686. ☽ 1.40 A.	4 14	7 40	11 17	0 38
15	Th		4 12	7 41	After	1 6
16	F	Major C. Russell d. 1887	4 11	7 43	1 38	1 31
17	S	Association Belge founded, 1874	4 9	7 44	2 45	1 55
18	S	Whit Sunday	4 8	7 46	3 51	2 18
19	M		4 6	7 47	4 56	2 42
20	Tu		4 5	7 49	5 59	3 8
21	W	Scheele d. 1786	4 4	7 50	7 0	3 36
22	Th	○ 10.46 M.	4 3	7 51	7 58	4 10
23	F	B. J. Sayce d. 1895	4 1	7 52	8 51	4 48
24	S		4 0	7 54	9 38	5 32
25	S	Trinity Sunday	3 59	7 55	10 18	6 24
26	M		3 58	7 57	10 54	7 20
27	Tu		3 57	7 58	11 25	8 20
28	W		3 56	7 59	11 53	9 23
29	Th	Sir H. Davy d. 1829	3 55	8 0	Morn	10 29
30	F	0.0 A.	3 54	8 2	0 19	11 38
31	S		3 53	8 3	0 43	After



BLACK PAPER against *face* of Film causes chemical fog. PIGMENT NUMBERS often show in negatives. [*See next page.*

THE THORNTON-PICKARD NEW MODEL FOCAL PLANE SHUTTER

SEE PAGE 1258

With Slit adjustable from the outside.

MAY.

D. M.	D. W.	MEMORANDA.
1	Th	
2	F	*For* Meetings of Societies, *see pp.* 623-675.
3	S	
4	S	
5	M	
6	Tu	
7	W	
8	Th	
9	F	
10	S	
11	S	
12	M	
13	Tu	
14	W	
15	Th	
16	F	
17	S	
18	S	
19	M	
20	Tu	
21	W	
22	Th	
23	F	
24	S	
25	S	
26	M	
27	Tu	
28	W	
29	Th	
30	F	
31	S	

PURE WHITE PAPER against *face* of Film, no harm. INNOCUOUS PERFORATED NUMBERS. [*See last page.*

WRATTEN'S 'LONDON' PLATES

Have been manufactured continuously for
TWENTY-FOUR YEARS,
and have never yet
been approached for
UNIFORMITY & EXCELLENCE.

JUNE.

D. M.	D. W.	Remarkable Events.	SUN.		MOON.	
			Rises. H. M.	Sets. H. M.	Rises. Morn.	Sets. After.
1	S	1st Sunday after Trinity	3 52	8 4	1 7	2 3
2	M	Niepce pub. his *Heliochromic Pro-*	3 51	8 5	1 33	3 19
3	Tu	[*cesses*, 1851	3 50	8 6	2 3	4 38
4	W	Tessié du Mothay d. 1880	3 50	8 7	2 38	5 56
5	Th	George Mason d. 1901, aged 62	3 49	8 8	3 20	7 11
6	F	● 6.11 M.	3 48	8 9	4 12	8 18
7	S	Fraunhofer d. 1826	3 47	8 10	5 16	9 15
8	S	2nd Sunday after Trinity	3 47	8 11	6 28	10 0
9	M	Alvan Clark d. 1897	3 46	8 12	7 43	10 38
10	Tu	[1853	3 46	8 13	9 0	11 9
11	W	Cutting's American Bromide pat.	3 46	8 13	10 14	11 36
12	Th	☽ 11.54 A.	3 46	8 14	11 26	Morn
13	F	[Niepce, 1837	3 45	8 14	After	0 1
14	S	Partnership between Daguerre and	3 45	8 15	1 43	0 24
15	S	3rd Sunday after Trinity	3 45	8 15	2 48	0 48
16	M	Chrysotype and Cyanotype Pro. com.	3 45	8 16	3 52	1 13
17	Tu	[to Royal Soc., 1842	3 44	8 16	4 54	1 40
18	W		3 44	8 17	5 53	2 12
19	Th	Abbé Laborde d. 1883	3 44	8 17	6 47	2 48
20	F	[1885. ○ 2.17 M.	3 44	8 18	7 36	3 30
21	S	Niepce Memorial uncov. at Chalons,	3 44	8 18	8 19	4 19
22	S	4th Sunday after Trinity	3 44	8 18	8 56	5 13
23	M		3 45	8 18	9 28	6 13
24	Tu	Hardwich d. 1890	3 45	8 19	9 57	7 16
25	W	[b. 1839	3 45	8 19	10 24	8 21
26	Th	W. B. Woodbury b. 1834. Liesegang	3 45	8 19	10 48	9 28
27	F	Herr Wothly d. 1873. G. Price d.	3 46	8 19	11 12	10 37
28	S	☾ 9.52 A. [1870	3 46	8 19	11 37	11 48
29	S	5th Sun. after Trinity. Ferrous-	3 47	8 18	Morn	After
30	M	[oxalate Developer pub. 1877	3 47	8 18	0 4	2 15

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THE
THORNTON-PICKARD
STUDIO
SHUTTER
SILENT
IN
OPERATION.
SEE
PAGE
1256

JUNE.

D. M.	D. W.	MEMORANDA.
1	S	
2	M	*For* **Meetings of Societies**, *see pp.* 623-675.
3	Tu	
4	W	
5	Th	
6	F	
7	S	
8	S	
9	M	
10	Tu	
11	W	
12	Th	
13	F	
14	S	
15	S	
16	M	
17	Tu	
18	W	
19	Th	
20	F	
21	S	
22	S	
23	M	
24	Tu	
25	W	
26	Th	
27	F	
28	S	
29	S	
30	M	

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JULY.

D. M.	D. W.	Remarkable Events.	Sun. Rises. H. M.	Sun. Sets. H. M.	Moon. Rises. Morn.	Moon. Sets. After.
1	Tu		3 48	8 18	0 35	3 32
2	W		3 49	8 18	1 12	4 46
3	Th		3 50	8 18	1 58	5 57
4	F		3 50	8 17	2 56	6 59
5	S	Nicephore Niepce d. 1833. ● 0.59 A.	3 51	8 17	4 1	7 52
6	S	6th Sunday after Trinity. W. I.	3 52	8 16	5 15	8 33
7	M	[Stillman d. 1901, aged 74	3 53	8 16	6 33	9 7
8	Tu		3 54	8 15	7 51	9 37
9	W		3 55	8 15	9 6	10 3
10	Th	Daguerre d. 1851	3 56	8 14	10 19	10 28
11	F	[1897. ☽ 0.47 A.	3 57	8 13	11 29	10 53
12	S	Wedgwood b. 1730. G. Dawson d.	3 58	8 12	After	11 18
13	S	7th S. aft. Trinity. Abbé Moigno	3 59	8 11	1 41	11 44
14	M	Dumas b. 1800 [d. 1884	4 0	8 10	2 44	Morn
15	Tu		4 1	8 9	3 44	0 14
16	W	Claudet b. 1797	4 2	8 8	4 41	0 48
17	Th	[1872	4 3	8 7	5 31	1 29
18	F	V. M. Griswold (Inv. Ferrotype) d.	4 4	8 6	6 17	2 15
19	S	[Process pub. 1852. ○ 4 45 A.	4 6	8 5	6 57	3 7
20	S	8th S. aft. Trin. Collodion Pos.	4 7	8 4	7 32	4 4
21	M	Regnault b. 1810	4 8	8 3	8 2	5 6
22	Tu		4 9	8 2	8 30	6 12
23	W		4 11	8 0	8 55	7 19
24	Th	Sir William Abney b. 1843	4 12	7 59	9 19	8 28
25	F		4 14	7 58	9 43	9 38
26	S	Niepce de St. Victor b. 1806	4 15	7 56	10 9	10 49
27	S	9th Sunday after Trinity	4 16	7 55	10 38	After
28	M	☾ 5.15 M.	4 17	7 53	11 11	1 14
29	Tu	Secchi b. 1818	4 19	7 52	11 52	2 28
30	W		4 20	7 51	Morn	3 39
31	Th	Wohler b. 1800.	4 22	7 50	0 41	4 43

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(See pages 1389 to 1410.)

THE THORNTON-PICKARD SNAP-SHOT SHUTTER

SEE PAGE 1255

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Simple and efficient.

JULY.

D. M.	D. W.	MEMORANDA.
1	Tu	***For* MEETINGS OF SOCIETIES, *see pp*. 623-675.**
2	W	
3	Th	
4	F	
5	S	
6	S	
7	M	
8	Tu	
9	W	
10	Th	
11	F	
12	S	
13	S	
14	M	
15	Tu	
16	W	
17	Th	
18	F	
19	S	
20	S	
21	M	
22	Tu	
23	W	
24	Th	
25	F	
26	S	
27	S	
28	M	
29	Tu	
30	W	
31	Th	

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(*See pages* 1389 *to* 1410)

WRATTEN'S CELEBRATED

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AUGUST.

D. M.	D. W.	REMARKABLE EVENTS.	SUN.		MOON.	
			Rises. H. M.	Sets. H. M.	Rises. Morn.	Sets. After.
1	F		4 24	7 48	1 41	5 38
2	S		4 25	7 46	2 51	6 26
3	S	10th Sun. after Trinity. Mungo	4 27	7 45	4 6	7 4
4	M	[Ponton d. 1880. ● 8.17 A.	4 28	7 43	5 24	7 36
5	Tu	Wollaston b. 1766. W. K. Burton	4 30	7 41	6 41	8 4
6	W	[d. 1899	4 31	7 39	7 57	8 31
7	Th	Berzelius d. 1848.	4 33	7 38	9 10	8 56
8	F	Roger Fenton d. 1869	4 34	7 36	10 20	9 21
9	S	[Harrison d. 1897	4 36	7 34	11 27	9 47
10	S	11th Sun. after Trinity. W. H.	4 37	7 32	After	10 16
11	M	☽ 4.24 M.	4 39	7 30	1 33	10 49
12	Tu		4 41	7 28	2 32	11 27
13	W	Prof. Stokes b. 1819	4 43	7 27	3 25	Morn
14	Th	Daguerreotype Process pat. 1839	4 44	7 25	4 13	0 10
15	F		4 45	7 23	4 56	1 0
16	S	Lavoisier b. 1743	4 46	7 21	5 31	1 55
17	S	12th Sunday after Trinity	4 48	7 19	6 4	2 56
18	M	Dr. Woodward (photo-microscopist)	4 49	7 17	6 33	4 1
19	Tu	○ 6.3 M. [d. 1884	4 51	7 15	6 59	5 8
20	W		4 53	7 13	7 24	6 17
21	Th	Chevreul b. 1786	4 55	7 11	7 48	7 27
22	F		4 56	7 9	8 14	8 38
23	S	[(Introd. of Ambrotype) d. 1867	4 58	7 7	8 43	9 51
24	S	13th Sun. aft. Trinity. Cutting	4 59	7 4	9 15	11 4
25	M	Faraday d. 1867	5 1	7 2	9 52	After
26	Tu	Paul Pretsch d. 1873. Daguerre	5 2	7 0	10 38	1 28
27	W	[Mem. uncovered, 1883. ☾ 11.5 M.	5 4	6 58	11 33	2 32
28	Th		5 5	6 56	Morn	3 29
29	F		5 7	6 54	0 36	4 18
30	S	Oliver Sarony d. 1879 [1821	5 9	6 51	1 47	4 58
31	S	14th S. aft. Trin. Helmholtz b.	5 11	6 49	3 1	5 33

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(*See pages* 1389 *to* 1410.)

THE THORNTON-PICKARD STEREOSCOPIC SHUTTER
Time and Inst. Exposures.
Note Reduced Prices.
SEE PAGE 1255

AUGUST.

D. M.	D. W.	MEMORANDA.
1	F	*For* Meetings of Societies, *see pp.* 623-675.
2	S	
3	**S**	
4	M	
5	Tu	
6	W	
7	Th	
8	F	
9	S	
10	**S**	
11	M	
12	Tu	
13	W	
14	Th	
15	F	
16	S	
17	**S**	
18	M	
19	Tu	
20	W	
21	Th	
22	F	
23	S	
24	**S**	
25	M	
26	Tu	
27	W	
28	Th	
29	F	
30	S	
31	**S**	

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SEPTEMBER.

D. M.	D. W.	Remarkable Events.	SUN. Rises. H. M.	SUN. Sets. H. M.	MOON. Rises. Morn.	MOON. Sets. After.
1	M	Norris's Dry-plate Process pat. 1856	5 12	6 47	4 17	6 3
2	Tu	● 5.19 M.	5 13	6 45	5 32	6 31
3	W		5 15	6 43	6 46	6 56
4	Th	Woodbury d. 1885	5 17	6 40	7 58	7 21
5	F	Pantascopic Camera patented, 1862	5 19	6 38	9 8	7 48
6	S	[Memorial inaugurated, 1885	5 20	6 36	10 16	8 16
7	S	15th Sun. aft. Trinity. Poitevin	5 22	6 34	11 20	8 47
8	M	Gel.-bro. Proc. pub. by Maddox, 1871	5 23	6 31	After	9 23
9	Tu	Col.-bro. Proc. pub. 1864. ☽ 10.15 A.	5 25	6 29	1 15	10 5
10	W		5 26	6 27	2 5	10 53
11	Th		5 28	6 25	2 50	11 46
12	F		5 29	6 22	3 28	Morn
13	S		5 31	6 20	4 3	0 44
14	S	16th Sun. aft. Trin. Humboldt	5 33	6 18	4 34	1 46
15	M	Petzval d. 1891 [b. 1769	5 35	6 16	5 1	2 51
16	Tu		5 36	6 13	5 26	4 0
17	W	Fox Talbot d. 1877. ○ 6.23 A.	5 38	6 11	5 51	5 11
18	Th	Leon Foucault b. 1819	5 39	6 9	6 17	6 24
19	F	T. Grubb d. 1878	5 41	6 7	6 45	7 38
20	S	Talbot's Discovery of Develop. 1840	5 42	6 4	7 17	8 52
21	S	17th Sun. aft. Trin. Stas b. 1813	5 44	6 2	7 53	10 6
22	M	Faraday b. 1791. Thos. Sutton b.	5 45	5 59	8 37	11 18
23	Tu	Woodbury Pro. pat. 1864 [1819	5 47	5 57	9 29	After
24	W	☾ 4 32 A.	5 49	5 55	10 30	1 25
25	Th	Dr. Van Monckhoven b. 1834, d. 1882	5 51	5 53	11 36	2 15
26	F		5 52	5 50	Morn	2 57
27	S	Kolbe b. 1818	5 54	5 48	0 47	3 33
28	S	18th Sunday after Trinity	5 55	5 46	2 1	4 4
29	M		5 57	5 44	3 15	4 32
30	Tu	Balard (Discoverer of Bromine) b. [1802	5 58	5 41	4 28	4 58

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(*See pages* 1389 *to* 1410.)

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SEE PAGES 1263 AND 1264

SEPTEMBER.

D. M.	D. W.	MEMORANDA.
1	M	*For* Meetings of Societies, *see pp.* 623–675.
2	Tu	
3	W	
4	Th	
5	F	
6	S	
7	S	
8	M	
9	Tu	
10	W	
11	Th	
12	F	
13	S	
14	S	
15	M	
16	Tu	
17	W	
18	Th	
19	F	
20	S	
21	S	
22	M	
23	Tu	
24	W	
25	Th	
26	F	
27	S	
28	S	
29	M	
30	Tu	

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WRATTEN'S 'LONDON' PLATES.

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OCTOBER.

D. M.	D. W.	Remarkable Events.	Sun. Rises. H. M.	Sun. Sets. H. M.	Moon. Rises. Morn.	Moon. Sets. After.
1	W	● 5.9 A.	6 0	5 38	5 40	5 23
2	Th	Arago d. 1853	6 2	5 36	6 50	5 48
3	F		6 4	5 34	7 58	6 16
4	S		6 5	5 32	9 4	6 47
5	S	19th Sunday after Trinity	6 7	5 30	10 7	7 22
6	M		6 8	5 27	11 5	8 1
7	Tu	Leon Warnerke d. 1900	6 10	5 25	11 57	8 46
8	W		6 12	5 23	After	9 37
9	Th	☽ 5.21 A.	6 14	5 20	1 24	10 32
10	F		6 15	5 18	2 1	11 31
11	S		6 17	5 16	2 32	Morn
12	S	20th Sun. aft. Trinity. Gmelin	6 18	5 14	3 0	0 35
13	M	[b. 1792	6 20	5 12	3 26	1 42
14	Tu		6 22	5 10	3 51	2 51
15	W		6 24	5 8	4 17	4 2
16	Th	[1887. ○ 6.1 M.	6 25	5 5	4 45	5 15
17	F	Reaumur d. 1757. Robert Hunt d.	6 27	5 3	5 16	6 31
18	S	Schonbein b. 1799. Wheatstone d.	6 29	5 1	5 51	7 48
19	S	21st Sun. aft. Trinity [1875	6 31	4 59	6 32	9 4
20	M		6 32	4 57	7 23	10 15
21	Tu		6 34	4 55	8 22	11 18
22	W		6 36	4 53	9 28	After
23	Th	☾ 10.58 A.	6 38	4 51	10 39	0 58
24	F		6 39	4 49	11 52	1 36
25	S	Vernon Heath d. 1895	6 41	4 47	Morn	2 8
26	S	22nd Sunday after Trinity	6 43	4 45	1 4	2 35
27	M		6 45	4 43	2 15	3 1
28	Tu	Col.-chlo. of Silver Process pub. 1864	6 46	4 41	3 26	3 26
29	W	Talbot Photo-eng. Process pat. 1852	6 48	4 39	4 37	3 51
30	Th		6 50	4 37	5 45	4 17
31	F	● 8.14 M.	6 52	4 35	6 51	4 47

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(*See pages* 1389 *to* 1410.)

THE THORNTON-PICKARD TRIPLE EXTENSION 'RUBY' CAMERA

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SEE PAGE 1265

OCTOBER.

D. M.	D. W.	MEMORANDA.
1	W	*For* Meetings of Societies, *see pp.* 623-675.
2	Th	
3	F	
4	S	
5	S	
6	M	
7	Tu	
8	W	
9	Th	
10	F	
11	S	
12	S	
13	M	
14	Tu	
15	W	
16	Th	
17	F	
18	S	
19	S	
20	M	
21	Tu	
22	W	
23	Th	
24	F	
25	S	
26	S	
27	M	
28	Tu	
29	W	
30	Th	
31	F	

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NOVEMBER.

D. M.	D. W.	Remarkable Events.	SUN. Rises. H. M.	Sets. H. M.	MOON. Rises. Morn.	Sets. After.
1	S		6 53	4 33	7 54	5 20
2	**S**	23rd Sunday after Trinity	6 55	4 31	8 54	5 56
3	M		6 57	4 30	9 49	6 39
4	Tu		6 59	4 28	10 38	7 28
5	W		7 1	4 26	11 22	8 21
6	Th	Senefelder b. 1771	7 2	4 24	11 59	9 19
7	F	Dubois Raymond b. 1818	7 4	4 23	After	10 20
8	S	J. Traill Taylor d. 1895. ☽ 0.31 A.	7 6	4 21	1 0	11 24
9	**S**	24th S. aft. Trin. Pretsch's Pho.-	7 8	4 20	1 27	Morn
10	M	Laroche d. 1886 [eng. Pro. pat. 1854	7 9	4 18	1 52	0 30
11	Tu	Willis's Aniline Process pat. 1864	7 11	4 17	2 17	1 39
12	W		7 13	4 15	2 43	2 50
13	Th		7 15	4 14	3 11	4 4
14	F		7 16	4 12	3 44	5 20
15	S	○ 5.7 A.	7 18	4 10	4 23	6 38
16	**S**	25th Sun. aft. Trinity. Lavater	7 20	4 9	5 11	7 54
17	M	[d. 1741	7 22	4 8	6 18	9 3
18	Tu	Daguerre b. 1787	7 23	4 6	7 14	10 4
19	W		7 25	4 5	8 24	10 55
20	Th	Prof. Draper d. 1882	7 26	4 4	9 40	11 37
21	F		7 28	4 3	10 55	After
22	S	Schlippe b. 1749. ☾ 7.47 M.	7 30	4 1	Morn	0 40
23	**S**	26th S. aft. Trin. Harrison (Inv.	7 32	4 0	0 7	1 7
24	M	[of Globe Lens) d. 1864	7 33	3 59	1 18	1 31
25	Tu		7 35	3 58	2 28	1 56
26	W		7 36	3 57	3 36	2 22
27	Th	Celsius b. 1701	7 38	3 56	4 42	2 49
28	F	Sutton Panoramic Camera pat. 1859	7 39	3 55	5 45	3 20
29	S		7 41	3 55	6 45	3 55
30	**S**	1st Sunday in Advent. ● 2.4 M.	7 42	3 54	7 42	4 36

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(*See pages* 1389 *to* 1410.)

THE
THORNTON-PICKARD
AUTOMATIC
TRIPODS
WITH
AUTOMATIC
SELF-LOCKING JOINTS.
SEE
PAGE
1272

NOVEMBER.

D. M.	D. W.	MEMORANDA.
1	S	
2	S	*For* MEETINGS OF SOCIETIES, *see pp.* 623–675.
3	M	
4	Tu	
5	W	
6	Th	
7	F	
8	S	
9	S	
10	M	
11	Tu	
12	W	
13	Th	
14	F	
15	S	
16	S	
17	M	
18	Tu	
19	W	
20	Th	
21	F	
22	S	
23	S	
24	M	
25	Tu	
26	W	
27	Th	
28	F	
29	S	
30	S	

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DECEMBER.

D. M.	D. W.	Remarkable Events.	SUN.		MOON.	
			Rises. H. M.	Sets. H. M.	Rises. Morn.	Sets. After.
1	M	Klaproth b. 1743	7 44	3 53	8 34	5 22
2	Tu		7 45	3 52	9 20	6 13
3	W		7 47	3 52	9 59	7 9
4	Th	Galvani d. 1798. R. Kennett d. 1896	7 48	3 51	10 33	8 9
5	F		7 50	3 51	11 3	9 11
6	S	Obernetter's Chromo-photo. pat. 1864	7 51	3 50	11 30	10 15
7	S	2nd Sunday in Advent	7 52	3 50	11 55	11 21
8	M	☽ 6.27 M.	7 53	3 50	After	Morn
9	Tu	Scheele b. 1742. Duc de Luynes d.	7 55	3 50	0 43	0 29
10	W	[1867	7 56	3 49	1 10	1 40
11	Th	Sir D. Brewster b. 1781	7 57	3 49	1 39	2 53
12	F	Rev. J. B. Reade d. 1870	7 58	3 49	2 13	4 8
13	S	First Photo-enam. Proc. pat. 1854	7 59	3 49	2 55	5 24
14	S	3rd Sun. in Advent. E. Anthony	8 0	3 49	3 47	6 38
15	M	○ 3.47 M. [d. 1888	8 1	3 49	4 49	7 47
16	Tu	H. Greenwood d. 1884. T. Ross d.	8 2	3 49	6 0	8 44
17	W	Sir Humphry Davy b. 1778 [1870	8 3	3 49	7 17	9 32
18	Th		8 3	3 49	8 35	10 11
19	F	Dr. H. W. Vogel d. 1898	8 4	3 49	9 51	10 44
20	S		8 4	3 50	11 5	11 11
21	S	4th Sunday in Advent. ☾ 8.0 A.	8 5	3 50	Morn	11 36
22	M	Wollaston d. 1828	8 5	3 51	0 17	After
23	Tu		8 6	3 51	1 26	0 27
24	W		8 6	3 52	2 32	0 53
25	Th	Christmas Day. Sir I. Newton b.	8 7	3 52	3 36	1 23
26	F	[1642	8 7	3 53	4 38	1 57
27	S	[Goddard d. 1866	8 8	3 54	5 37	2 35
28	S	Sunday after Christmas. J. T.	8 8	3 55	6 31	3 18
29	M	● 9.25 A.	8 8	3 55	7 18	4 7
30	Tu	J. H. Dallmeyer d. 1883	8 8	3 56	8 0	5 2
31	W	A. Braun d. 1877	8 8	3 57	8 37	6 1

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(*See pages* 1389 *to* 1410.)

THE THORNTON-PICKARD PATENT PLATE-HOLDER
ABSOLUTELY LIGHT-PROOF.
SEE PAGE 1273

DECEMBER.

D. M.	D. W.	MEMORANDA.
1	M	*For* Meetings of Societies, *see pp.* 623–675.
2	Tu	
3	W	
4	Th	
5	F	
6	S	
7	S	
8	M	
9	Tu	
10	W	
11	Th	
12	F	
13	S	
14	S	
15	M	
16	Tu	
17	W	
18	Th	
19	F	
20	S	
21	S	
22	M	
23	Tu	
24	W	
25	Th	
26	F	
27	S	
28	S	
29	M	
30	Tu	
31	W	

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20 Ounces = 1 Pint.
8 Pints = 1 Gallon.

The above weights are those usually adopted in formulæ.

All Chemicals are usually sold by Avoirdupois Weight, in which there are 437½ grains to the ounce.

The Precious Metals, such as Silver and Gold, are sold by Troy Weight, containing 480 grains to the ounce.

FRENCH FLUID MEASURES, AND THEIR EQUIVALENTS IN ENGLISH.

[*See also other tables in this section.*]

1 Cubic Centimètre = 17 minims nearly.
3½ „ „ = 1 drachm.
28·4 „ „ = 1 ounce.
50 „ „ = 1 ounce, 6 drachms, 5 minims.
100 „ „ = 3 ounces, 4 drachms, 9 minims.
1000 „ „ or 1 litre, = to 61 cubic inches } = 35 ounces, 1 drachm, 36 minims.

The unit of French liquid measures is a cubic *centimètre.*

A cubic *centimètre* of water measures nearly 17 minims (16·896); it weighs 15·4 grains, or 1 *gramme.* A cubic *inch* of water weighs 252·5 grains.

The unit of French weights is the gramme = 15·4 grains; thus a drachm (60 grains) is nearly 4 grammes (3·88). An easy way to convert grammes into English weight is to divide the sum by 4, which gives the equivalent in drachms very nearly thus:—

Grammes. Drachms. Oz. Drachm. Grains.
100 ÷ 4 = 25 = 3 . 1 + 43

FRENCH INTO ENGLISH FLUID MEASURES.

THE following table will prove to be sufficiently accurate for photographic purposes :—

1	cubic centimètre	=	17	minims (as near as possible).							
2	cubic centimètres	=	34	,,							
3	,,	=	51	,,							
4	,,	=	68	,,	or	1	drachm	8	minims.		
5	,,	=	85	,,	,,	1	,,	25	,,		
6	,,	=	102	,,	,,	1	,,	42	,,		
7	,,	=	119	,,	,,	1	,,	59	,,		
8	,,	=	136	,,	,,	2	drachms	16	,,		
9	,,	=	153	,,	,,	2	,,	33	,,		
10	,,	=	170	,,	,,	2	,,	50	,,		
20	,,	=	340	,,	,,	5	,,	40	,,		
30	,,	=	510	,,	,,	1	ounce	0	drachm	30	minims.
40	,,	=	680	,,	,,	1	,,	3	drachms	20	,,
50	,,	=	850	,,	,,	1	,,	6	,,	10	,,
60	,,	=	1020	,,	,,	2	ounces	1	,,	0	,,
70	,,	=	1190	,,	,,	2	,,	3	,,	50	,,
80	,,	=	1360	,,	,,	2	,,	6	,,	40	,,
90	,,	=	1530	,,	,,	3	,,	1	,,	30	,,
100	,,	=	1700	,,	,,	3	,,	4	,,	20	,,

FRENCH INTO ENGLISH WEIGHTS.

1	gramme	=	15⅖	grains.						
2	grammes	=	30⅘	,,						
3	,,	=	46⅕	,,						
4	,,	=	61⅗	,,	....	or	1	drachm	1⅗	grain.
5	,,	=	77	,,	....	,,	1	,,	17	grains.
6	,,	=	92⅖	,,	....	,,	1	,,	32⅖	,,
7	,,	=	107⅘	,,	....	,,	1	,,	47⅘	,,
8	,,	=	123⅕	,,	....	,,	2	drachms	3⅕	,,
9	,,	=	138⅗	,,	....	,,	2	,,	18⅗	,,
10	,,	=	154	,	....	,,	2	,,	34	,,
11	,,	=	169⅖	,,	....	,,	2	,,	49⅖	,,
12	,,	=	184⅘	,,	....	,,	3	,,	4⅘	,,
13	,,	=	200⅕	,,	....	,,	3	,,	20⅕	,,
14	,,	=	215⅗	,,	....	,,	3	,,	35⅗	,,
15	,,	=	231	,,	....	,,	3	,,	51	,,
16	,,	=	246⅖	,,	....	,,	4	,,	6⅖	,,
17	,,	=	261⅘	,,	....	,,	4	,,	21⅘	,,
18	,,	=	277⅕	,,	....	,,	4	,,	37⅕	,,
19	,,	=	292⅗	,,	....	,,	4	,,	52⅗	,,
20	,,	=	308	,,	....	,,	5	,,	8	,,
30	,,	=	462	,,	....	,,	7	,,	42	,,
40	,,	=	616	,,	....	,,	10	,,	16	,,
50	,,	=	770	,,	....	,,	12	,,	50	,,
60	,,	=	924	,,	....	,,	15	,,	24	,,
70	,,	=	1078	,,	....	,,	17	,,	58	,,
80	,,	=	1232	,,	....	,,	20	,,	32	,,
90	,,	=	1386	,,	....	,,	23	,,	6	,,
100	,,	=	1540	,,	....	,,	25	,,	40	,,

NEW METRIC WEIGHTS AND MEASURES.

[From the *Journal* of the Royal Photographic Society.]

In accordance with a resolution passed by the Council of this Society, directing the publication, in the Journal, of the Order in Council dated May 19, 1898, substituting a new table of imperial and metric equivalents for that set forth in Part I. of the Third Schedule of the Weights and Measures Act, 1878, we give below an abstract from the new Schedule of such measures of weight, length, capacity, &c., which are in common use amongst photographers in this country.

Equivalents of Metric Weights and Measures in Terms of Imperial Weights and Measures.

Linear Measure.

1 Millimetre (Mm.) (1/1000th M.)	=	0·03937 Inch.
1 Centimetre (1/100th M.)......	=	0·3937 ,,
1 Decimetre (1/10th M.)	=	3·937 Inches
1 Metre (M.)......................	=	39·370113 Inches 3·280843 Feet 1·0936143 Yards
1 Dekametre (10 M.)	=	10·936 Yards
1 Hectometre (100 M.)	=	109·36 ,,
Kilometre (1000 M.)	=	0·62137 Mile

Square Measure.

1 Square Centimetre	=	0·155 Square Inch
1 ,, Decimetre (100 Sq. Centimetres)	=	15·5 Square Inches
1 Square Metre (100 Square Decimetres)	=	10·7639 Square Feet 1·196 Square Yards

Cubic Measure.

1 Cubic Centimetre...............	=	0·061 Cubic Inch
1 ,, Decimetre (C.D.)(1000 Cubic Centimetres)	=	61·024 Cubic Inches
1 Cubic Metre (1000 Cubic Decimetres)	=	35·3148 Cubic Feet 1·307954 Cubic Yards

Measure of Capacity.

1 Centilitre (1/100th Litre) ...	=	0·07 Gill
1 Decilitre (1/10th Litre)	=	0·176 Pint
1 Litre	=	1·7598 Pints
1 Dekalitre (10 Litres)	=	2·2 Gallons

WEIGHT. *Avoirdupois.*

1 Milligramme(1/1000thGrm.) = 0·015 Grain
1 Centigramme(1/1000thGrm.) = 0·154 ,,
1 Decigramme (1/10th Grm.) = 1·543 Grains
1 Gramme (1 Grm.) .... = 15·432 ,,
1 Dekagramme (10 Grm.) ...... = 5·644 Drachms
1 Hectogramme (100 Grm.) ... = 3·527 Ounces
1 Kilogramme (1000 Grm.) ... = { 2·2046223 lbs. or
15432·3564 Grains }
1 Quintal (100 Kilog.) .... = 1·968 Cwt.

Apothecaries'.

1 Gramme (1 Grm.) .... = { 0·2572 Drachm
0·7716 Scruple
15·432 Grains }

Troy.

1 Gramme (1 Grm.) .... = 0·03215 Ounce

Equivalent of Imperial Weights and Measures in Terms of Metric Weights and Measures.

LINEAR MEASURE.

1 Inch .... = 25·4 Millimetres
1 Foot .... = 0·3048 Metre
1 Yard .... = 0·914399 ,,
1 Mile .... = 1·6093 Kilometre

SQUARE MEASURE.

1 Square Inch .... = 6·4516 Square Centimetres
1 ,, Foot .... = 9·2903 ,, Decimetres
1 ,, Yard...................... = 0·836126 ,, Metre
1 ,, Mile .... = 259·0 Hectares

CUBIC MEASURE.

1 Cubic Inch .... = 16·387 Cubic Centimetres
1 ,, Foot .... = 0·028317 Cubic Metre
1 ,, Yard .... = 0·764553 ,, ,,

MEASURES OF CAPACITY.

1 Pint .... = 0·568 Litre
1 Quart .... = 1·136 ,,
1 Gallon .... = 4·5459631 Litres

APOTHECARIES' MEASURE.

1 Minim .... = 0·059 Millimetre
1 Fluid Scruple .... = 1·184 ,,
1 ,, Drachm (60 Minims.) = 3·552 Millimetres
1 ,, Ounce (8 Drachms) ... = 2·84123 Centilitre
1 Pint .... = 0·568 Litre

AVOIRDUPOIS WEIGHT.

1 Grain	=	0·0648 Gramme
1 Ounce	=	28·350 Grammes
1 Pound	=	0·45359243 Kilogramme
1 Hundredweight	=	50·80 Kilogrammes

APOTHECARIES' WEIGHT.

1 Grain	=	0·0648 Gramme
1 Scruple (20 Grains)	=	1·296 Grammes
1 Drachm (3 Scruples)	=	3·888 ,,
1 Ounce (8 Drachms)	=	31·1035 ,,

Note.—The Metre is represented by the distance marked by two fine lines on the iridio-platinum standard bar numbered 16, when at the temperature of 0° Centigrade. This bar is deposited with the Board of Trade. The metre is the only unit of metric measure of extension from which all other metric measures of extension, whether linear, superficial, or solid, shall be ascertained.

The Kilogramme is represented by the cylindrical iridio-platinum standard kilogramme weight numbered 18, which is deposited with the Board of Trade. The kilogramme is the only unit of metric weight from which all other metric weights, and all measures having reference to metric weight, shall be ascertained.

The Litre is represented by the capacity at 0° Centigrade of the cylindrical brass measure marked 'litre, 1897' (which is deposited with the Board of Trade), and having a diameter equal to one-half its height. This litre at 0° Centigrade when full contains one kilogramme of distilled water at the temperature of 4° Centigrade, under an atmospheric pressure equal to that represented by a column of mercury 760 millimetres high at 0° Centigrade at sea-level, and at latitude 45°, the weighing being made in air, but reduced by calculation to a vacuum. It is the only unit of metric measure of capacity from which all other metric measures of capacity, as well for liquids as for dry goods, shall be ascertained.

POSTAL INFORMATION.

INLAND LETTERS.

The rates for Inland Letters are as follows :—

4 ozs.	1*d.*	10 ozs.	2½*d.*	16 ozs.	4*d.*
6 ozs.	1½*d.*	12 ozs.	3*d.*	18 ozs.	4½*d.*
8 ozs.	2*d.*	14 ozs.	3½*d.*	20 ozs.	5*d.*

and so on for greater weights at ½*d.* extra for every additional 2 ozs. No letter may exceed 24 in. long, 12 in. wide, or 12 in. deep. Letters posted unpaid are charged double postage on delivery; those insufficiently paid, double the deficiency.

EXPRESS DELIVERY.—Letters and parcels are accepted at most of the principal offices for express delivery, at an extra charge of 3*d.* for every mile or part. The cost of cab hire extra if required. The packet must be handed over counter at the Post Office, with postage and fee affixed in stamps, and "Express Delivery" boldly written at top left corner.

Single letters not exceeding 4 ozs. in weight can be sent by railway. The postage and a fee of 2*d.* must be paid to the railway servant receiving such letter, and he will affix and obliterate a special label. Such letters *must be* taken to a passenger station, and will be sent to destination by first available train. They may be addressed to the Parcel Office at the station of destination "to be called for," or, if so desired, will be posted in the nearest Post Office to the station to which addressed for delivery by ordinary post.

INLAND NEWSPAPERS.

The ordinary postal rate on newspapers is a halfpenny for every 2 ozs.; but publications which consist wholly or in part of news, or articles on current topics, and which are printed and published in the United Kingdom at intervals of not more than seven days, may—for an annual fee of 5*s.*—be registered for transmission by post in the United Kingdom at the newspaper rate of a halfpenny each, irrespective of weight. The full title and date of publication must be printed at the top of first page, and the date and part or all of the title on every other page No newspaper packet may be above 5 lbs. in weight, 24 in. long, 12 in. wide, or 12 in. deep. Registered newspapers must be so folded that the title may easily be read, and must be posted either without a cover, or in one open at the ends, so as to admit of easy removal for examination. Nothing of the nature of a letter may be written on the newspaper or its cover, except a reference to any part of such paper.

NEWSPAPER WRAPPERS.—Halfpenny stamp, ¾*d.* each, 7 for 4*d.*, or 22*s.* 10*d.* per 480. Penny stamp, 1¼*d.* each; 8 for 8½*d.*, or 21*s.* 3*d.* per 240. Sheets of halfpenny wrappers may be obtained at 2 days' notice in packets of 120 sheets of 14 wrappers each at £3 18*s.*

INLAND BOOK POST.

Except in regard to 2-ozs. packets, which may still be sent for a halfpenny, the Book Post is practically abolished, all packets over 2 ozs. being subject to the same rates and regulations as Letters (which see).

A 2-oz. Book Packet may contain any matter wholly printed on paper, or other substance in ordinary use for printing; books or literary publications, sketches, drawings, paintings, maps, plans, &c.; invoices, advice notes, bills of lading, and similar commercial and legal documents, provided that nothing is written on them of the nature of a letter, or other entries proper to such documents; proofs or manuscripts for press, and examination papers under similar conditions, and circulars or printed notices. The circular may be altered in writing, and, in the case of notices of meeting, the place, hour, date, and objects may also be inserted. (The word "printed" is intended to cover only forms produced in numbers by ordinary mechanical means; imitation type-written circulars are included if in identical terms and in numbers of not less than 20 specially handed over the counter at a Post Office and attention called to their nature.) A Book Packet may be posted either without a cover, or in one open at both ends, so as to admit of easy withdrawal for examination. The ends may be secured with string, but stamps may not be fixed partly to the wrapper, and partly on the publication.

INLAND PARCELS POST.

Parcels for conveyance within the United Kingdom can be posted at any Post Office. The limit of length allowed is 3 ft. 6 in., and the maximum of length and girth is 6 ft., *i.e.*, a Parcel 3 ft. 6 in. long may measure 2 ft. 6 in. in girth round the thickest part. The Rates of Postage, which must be prepaid, are as follows:

1 lb.	3*d.*	5 lbs.	7*d.*	9 lbs.	0*s.* 11*d*
2 lbs....	4*d.*	6 ,, ...	8*d.*	10 ,, ...	1*s.* 0*d.*
3 ,, ...	5*d.*	7 ,, ...	9*d.*	11 ,, ...	1*s.* 0*d.*
4 ,, ...	6*d.*	8 ,, ...	10*d.*		

11 lbs. is the limit allowed.

[illegible]

'BARNET'

BROMIDE PAPER

[illegible]

BARNET PLATES & Papers.

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POSTAL—"ELLIOTT & SONS, LTD , BARNET."

TELEPHONE— "No. 11 BARNET."

TELEGRAMS— "ELLIOTT, BARNET."

1902.

Speeds and . . .
Qualifications of

BARNET PLATES

	Approximate Speeds.*		
	H. & D.	Watkins.	Wynn.
Barnet "Ordinary" Plate. For Field, general purposes, and Copying, and specially recommended to beginners; it is thickly coated and allows great latitude in exposure. Used in conjunction with our Exposure Cards (one of which is enclosed with each box), wrong exposure is almost impossible.	50	64	f 64
Barnet "Medium" Plate. For Field or Studio Work. This Brand combines the advantages of good average speed, with superlative quality. We can confidently recommend it as the most perfect all-round Plate. When in doubt as to what plate to use, the Barnet Medium can be adopted with certainty of success.	100	128	f 90
Barnet "Extra Rapid" Plate. For Studio and Landscape, and recommended to Hand Camerists; the most popular instantaneous plate. Made always up to speed. ¼-plates accurately cut, and on thin glass.	200	256	f 128
Barnet "Rocket" Plate. The quickest plate made, and exceptionally fine in grain. It can be forced to any reasonable extent without fogging. Specially made for all classes of high speed shutter work. Thickly coated. ¼-plates accurately cut from thin crystal glass.	250	300	f 156

Barnet "Lantern" Plate.

A wide range of tones can be obtained, from black to warm red, by simple variation of exposure and development. Explicit instructions enclosed with each box.

Barnet "Photo-Mechanical" Plate.

Specially manufactured to suit the requirements of process workers in line and half tone.

NOTE.

The Hurter & Driffield, Watkins or Wynn Speed Meters can be obtained through any Dealer of standing.

* *Important Notice. . .* It is well to note that the Speed Numbers we have given indicate the actual speeds attained with the use of our "Standard Developer," as being more practical for every-day use than the Standard Ferrous Oxylate Developer used for scientific measurements. Our speed numbers may of course be doubled by using the more powerful developers.

ELLIOTT & SONS, LTD., BARNET, HERTS, ENG.

Barnet Plates.

Size.	PHOTO-MECHANICAL ORDINARY, MEDIUM, EXTRA RAPID, AND LANTERN.	ROCKET. Black Label, Red Letters.	Additional Price for Backing.
	PER DOZ.	PER DOZ.	PER DOZ.
1¼ by 1¼	/6 (on Thin Glass /8)	/9	—
2 ,, 2	/6 (,, /8)	/9	—
2 5/16 ,, 1¾	/6 (,, /8)	/10	—
3½ ,, 2½	/9 (,, /10)	1/0	—
4¼ ,, 3¼	1/0	1/6	–/3
5 ,, 4	1/7	2/6	–/4
6½ ,, 4¼	2/2	3/3	–/6
6½ ,, 4¾	2/3	3/8	–/6
7¼ ,, 4½	2/10	4/6	–/6
7½ ,, 5	3/5	5/3	–/9
8½ ,, 6½	4/3	6/6	–/9
9 ,, 7	5/0	8/0	–/9
10 ,, 8	7/3	10/6	1/0
13 ,, 8	10/0	15/0	1/3
12 ,, 10	10/6	16/0	1/6
15 ,, 12	18/0	28/0	2/0
18 ,, 16	32/6	50/0	3/0
24 ,, 18	51/0	76/6	—
24 ,, 20	60/0	90/0	—

Other sizes made to order. 8½ × 6½ are packed in half-dozens to order at 6d. per dozen extra. 10 × 8 and upwards are packed in half-dozens without extra charge.

ALL PLATES FOR EXPORT ARE SPECIALLY PREPARED AND PACKED.

Price List of Continental Sizes see page 610.

ELLIOTT & SONS, Ltd., Barnet, Herts, Eng.

Prices of Plates, Bromide Paper, P.O.P., and Films.

CONTINENTAL SIZES.

BARNET PLATES.

Centimetres.	All Plates except "Rocket."	"Rocket."
4·5 × 6	/6 per doz. (on Thin Glass, /8)	/10 per doz.
6·5 × 9	/9 ,, ,, ,, /10)	1/0 ,,
9 × 12	1/4 ,,	2/0 ,,
12 × 16½	2/3 ,,	3/8 ,,
13 × 18	2/8 ,,	4/0 ,,
18 × 24	5/0 ,,	8/0 ,,

Other sizes in proportion.

BARNET BROMIDE PAPERS.

All Papers except Enamel Surface Papers.

Centimetres.	6 sheets.	12 sheets in packets
9 × 12	—	/9
12 × 16½	—	1/0
13 × 18	—	1/4
18 × 24	1/4	2/6
24 × 30	2/3	4/2 in Tube or Pkt.
30 × 40	3/6	6/9 ,,

Other sizes in proportion.

NOTE.—When ordering please say if required flat or in roll.

BARNET P.O.P.

Centimetres.		
9 × 12	24 pieces	/10
12 × 16½	24 ,,	1/4
13 × 18	24 ,,	1/8
18 × 24	12 ,,	1/5

BARNET FILMS—Cut Sizes.

Centimetres.	"Ordinary" and "Extra Rapid"	"Rocket"
9 × 12	2/0 per dozen	2/10 per dozen.
12 × 16½	3/8 ,,	4/6 ,,
13 × 18	4/0 ,,	5/3 ,,
18 × 14	8/0 ,,	10/0 ,,

AGENTS ALL OVER THE WORLD.

ELLIOTT & SONS, Ltd. Barnet, Herts, England.

BARNET LANTERN PLATE.

1/- PER DOZ.

FOR WARM OR COLD TONES.

Every Box contains full instructions for working and for the obtaining of a wide range of tones.

Those who seek further instruction in Slide Making are referred to the highest authority on the subject, MR. ANDREW PRINGLE, *in his excellent article written expressly for us in*

The Barnet Book of Photography. Price 1/-. Postage 4d.

SOLE MANUFACTURERS—

ELLIOTT & SONS, Ltd., Barnet, England.

NEGATIVE TAKEN ON A BARNET "EXTRA RAPID" CUT FILM

Specially recommended to Cyclists and Travellers, having the advantage of being Portable, Unbreakable, and Absolutely Reliable.

Neg. by Hubert J. Elliott

PARTICULARS OF EXPOSURE.

Switzerland. 5,500 ft.
August. 11 a.m.
Sunlight.
Stop, *f* 8.
Exposure, $\frac{1}{32}$ second.

Size.	Ordinary and Extra Rapid.	Rocket.
4¼ by 3¼	**1/6** per doz.	**2/0** per doz.
5 ,, 4	**2/6** ,,	**3/0** ,,
6½ ,, 4¾	**3/8** ,,	**4/6** ,,
8½ ,, 6½	**6/6** ,,	**8/0** ,,
10 ,, 8	**10/6** ,,	**12/0** ,,

Other sizes on application.

Sole Manufacturers:

ELLIOTT & SONS, Ltd., Barnet, Herts, England.

BARNET PLATES

Are specially prepared and packed for the

TRŌPICS

Can be developed in high temperatures without frilling

LARGELY EXPORTED to all parts of The WORLD.

Manufactured by ELLIOTT & SONS LTD, BARNET, ENGLAND.

BARNET BROMIDE PAPER

PLATINO-MATT & ORDINARY.

PLATINO-MATT	Smooth	**UNIFORM PRICE.**
Do. do.	Rough	
Do. do. ..	Cream Crayon	
ORDINARY ENLARGING ..	Rough	
Do. do. ..	Smooth	

	s.	d.		s.	d.	
2 5/16 by 1¾	—		24 pieces	0	6	... ...
2¼ ,, 2¼	—		,,	0	6	... ...
2½ ,, 2½	—		,,	0	6	... ...
	6 SHEETS.		**12 SHEETS in Packet.**			
4¼ ,, 3¼	—		...	0	6	... ...
5 ,, 4	—		...	0	9	... ...
6½ ,, 4¾	—		...	1	0	... ...
7½ ,, 5	—		...	1	3	... ...
8½ ,, 6½	—		...	2	0	... ...
10 ,, 8	—		...	2	9	in Tube or Packet.
12 ,, 10	2	2	...	4	2	,, ,, ,,
12½ ,, 10½	2	4	...	4	6	,, ,, ,,
15 ,, 12	3	3	...	6	3	,, ,, ,,
15½ ,, 12½	3	6	...	6	9	,, ,, ,,
18 ,, 15	5	0	...	9	6	,, ,, ,,
23 ,, 17	6	9	...	12	6	,, ,, ,,
25 ,, 21	9	6	...	18	0	,, ,, ,,
30 ,, 25	13	6	...	26	0	,, ,, ,,

NOTE.—When ordering please say if required flat or in roll.

ROLLS.

	s.	d.
Rolls of 10 feet, 24½ inches wide	8	6
,, 25 ,, 40 ,, ,, ...	35	0
,, 25 ,, 25 ,, ,, ...	22	0
Gross Boxes of Cabinet	10	0

Rolls of any width up to 40 inches cut to order.

THE CREAM CRAYON specially lends itself to Sepia Toning. Formula on application.

ELLIOTT & SONS, Ltd., Barnet, Herts, England.

IN THE WINTER LONG EVENINGS

MAKE
CONTACT
PRINTS ON

Barnet Bromide Papers

Platino-Matt

SPECIMEN PRINT
OPPOSITE PAGE 607.

Elliott & Sons, Ltd.,
Barnet, Herts,
England.

Barnet Snow Enamel & Pink Enamel BROMIDE PAPER.

These Bromide Papers have a highly Enamelled Surface, giving a purity of effect, and a minute rendering of detail, so essential in many classes of work. Prints can be made and finished by this process in a few hours. Manipulated in same way as Platino-Matt.

PACKETS OR TUBES.

4¼ by 3¼		12 sheets	0/8
5 ,, 4		12 ,,	1/0
6½ ,, 4¾		12 ,,	1/6
7½ ,, 5		12 ,,	1/8
8½ ,, 6½		12 ,,	2/6
10 ,, 8		12 ,,	3/6
12 ,, 10		12 ,,	5/0
12½ ,, 10½		12 ,,	5/6
15 ,, 12	for 6 sheets 3/6	for 12 sheets	7/0
15½ ,, 12½	,, 3/9	,,	7/6
23 ,, 17	,, 7/0	,,	14/0
25 ,, 21	,, 10/6	,,	21/0
30 ,, 25	,, 14/3	,,	28/6
40 ,, 30	,, 23/3	,,	46/6

NOTE.—When ordering please say if required flat or in roll.

25-feet ROLLS.

12 inches wide	11/10
18 ,,	17/4
25 ,,	24/4
30 ,,	29/2

FOR WINTER WORK.—All the advantages of Bromide and P.O.P. are incorporated in Barnet Enamel Papers.

MANUFACTURED BY

ELLIOTT & SONS, Ltd., Barnet, Herts, England.

Barnet P.O.P.

Mauve.
White.
Pink.

Packets	2 5/16 by 1¾	36 pieces	-/6
	2½ ,, 2½	36 ,,	-/6
	3½ ,, 2½	57 ,,	1/0
	3¼ ,, 3¼	47 ,,	1/0
	3½ ,, 3½	40 ,,	1/0
	4 ,, 3	42 ,,	1/0
	4¼ ,, 3¼	36 ,,	1/0
	5 ,, 4	24 ,,	1/0
	6 ,, 4¼	24 ,,	1/0
	6½ ,, 4¾	16 ,,	1/0
	7½ ,, 5	12 ,,	1/0
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Brighouse Photographic Society.—(ESTABLISHED 1894.)—*President*—Dr. George A. Farrer. *Vice-Presidents*—G. Hepworth, A. H. Ormerod, J. E. Longbottom. *Committee*—H. P. Metcalfe, F. Healey, H. Sugden, A. Capstick, H. Mitchell, F. Cooke, F. Hirst. *Treasurer*—John Wood. *Secretaries*—J. H. Georgeson, Halifax Road, Brighouse; F. W. Crowther, 11 Anvil Street, Brighouse.

Bristol and West of England Amateur Photographic Association.—(ESTABLISHED 1866.)—Meetings are held at the Literary and Philosophic Club, Berkeley Square, Bristol. *President*—H. A. Hood Daniel. *Vice-Presidents*—H. Ormerod and E. Brightman. *Council*—The Officers, and T. Butler, H. O. Isaac, S. J. Hill, M. Lavington, W. Norgrove. *Treasurer*—W. Moline. *Secretaries*—E. Brightman, 61 Redland Road, Bristol, and Guy Chilton, 34 Baldwin Street, Bristol.

British Association for the Advancement of Science.—(ESTABLISHED 1831.)—Meeting to be held on September 10–17 at Belfast. The meeting in 1903 will be held at Southport. *President*—Principal A. W. Rücker, F.R.S. *President Elect for Belfast*—Prof. J. Dewar, F.R.S. *Treasurer*—Prof. G. C. Foster, F.R.S. *Secretary*—G. Griffith, M.A., Burlington House, W.

British Postal Camera Club.—(ESTABLISHED ABOUT 1893–94.)—*Committee*—Mrs. Cottam, H. C. Leat, P. H. Mason. *Hon. Secretary*—Hugh Price, Dennis Vale, Stourbridge, Worcestershire.

Brixton and Clapham Camera Club.—(ESTABLISHED 1889.)—Meetings are held at Brixton Hall, Acre Lane, Brixton, S.W. *President*—W. E. Dunmore. *Vice Presidents*—W. Fraser and F. W. Levett. *Council*—A. R. Clinch, T. W. R. Cundall, R. Fisher, C. E. Scales, W. Steers. *Librarian and Curator*—W. W. Redman. *Lanternist*—R. G. Mason. *Secretary*—W. H. Stoneman. *Assistant Secretary*—L. W. R. Cundall, 11 Endymion Road, Brixton Hill, S.W.

Bromley (Kent) Camera Club.—(ESTABLISHED 1896.)—Meetings held at the School of Science and Art, Bromley, Kent. *President*—Samuel B. Webber. *Vice-Presidents*—William Willis and Thomas Davis, J.P. *Committee*—Henry C. Bond, M.A., F.C.S., W. L. Crossley, R. W. James, M.I.C.E., M.I.M.E., Henry J. Tweedy, B.A., Albert S. Hicks, F.C.A., John Scott, B.A., M.B. (Chairman). *Hon. Secretary and Treasurer*—Edgar T. Godward.

Bromsgrove School Photographic Society.—(ESTABLISHED 1893.)—Headquarters, Bromsgrove School. *President*—Rev. J. L. Langdon-Fulford, M.A. *Hon. Treasurer*—L. E. Barrington Wood. *Hon. Secretary*—R. Lakin, The School, Bromsgrove, Worcestershire.

Burnley Camera Club.—(ESTABLISHED 1897.)—Meetings are held at the Mechanics' Institution, Burnley. *President*—Frederick Heap. *Vice-Presidents*—Dr. Crump, B.A., B. Slater, W. Sutcliffe. *Committee*—A. A. Bellingham, A. Greenwood, F. Pinder, A. Stell, T. Walton, A. Harrison. *Secretary*—Percy Brotherton, *Express* Office, Burnley, or 19 Ormerod Road.

Burton-on-Trent Natural History and Archæological Society (Photographic Section).—(ESTABLISHED 1889.)—Meetings held at the Young Men's Christian Association. *President*—R. Churchill. *Secretary*—H. H. Port, 103 Scalpcliffe Road, Burton-on-Trent.

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Bury Camera Club.—(ESTABLISHED 1900.)—Meetings held at The Studio, Fishpool. *President*—Alderman John Ward. *Vice-Presidents*—E. W. Mellor, J.P., H. M. Dearden, R. Wood. *Committee*—A. Ashworth, T. M. Barbour, G. Slater, G. R. Ross, T. Hayhurst. *Treasurer*—W. Ward. *Secretary*—J. Nichols, 36 Nelson Street, Fishpool, Bury.

Cambridge Y.M.C A. Camera Club.—(ESTABLISHED 1896.)—Meetings held at the Alexandra Hall (Y.M.C.A.). *President*—F. W. Bird. *Vice-President*—W. H. Hayles. *Committee*—S. Cowles, A. R. Crossman, F. P. Dew, A. Howard, A. Smith, H. L. Smith, T. Sowdon, J. Tyler. *Treasurer*—W. H. Hayles. *Secretary*—A. Winton Goatcher, The Observatory, Cambridge.

Camera & Company Postal Photographic Circulating Club.—(ESTABLISHED 1891.)—*Secretary*—Frank H. Read, Ferndale, 7 Clifden Road, Brentford, Middlesex.

Camera Club.—(ESTABLISHED 1885.)—Meetings are held at 28 Charing Cross Road, W.C. *President*—Sir W. de W. Abney, F.R.S. *Vice-President*—Arthur R. Price. *Committee*—Percy E. Marshall, Henry E. Davis, Dr. Abraham, F.R.C.S.I., Earl of Rosse, Earl of Crawford, Rev. N. R. Fitzpatrick, M.A., A. C. Beard, E. H. Laurie, I. G. Gordon, G. A. T. Middleton, A.R.I.B.A., Thomas Bedding, J. Cadett. *Hon. Librarian*—Lyonel Clark. *Hon. Assistant Librarian*—William Brooks. *Hoa. Legal Adviser*—W. Asbury Greene. *Bankers*—Martin's Bank, Limited. *Hon. Secretary*—H. H. O'Farrell. *Secretary and Manager*—George A. Richardson, 28 Charing Cross Road, W.C.

Cardiff Photographic Society.—(ESTABLISHED 1886.)—Meetings are held at 7 and 8 Working Street, Cardiff. *President*—William Booth. *Vice Presidents*—S. W. Allen, S. C. Fox, W. J. Jenkins, A. McKinnon, *Treasurer*—G. P. Nance. *Secretary*—J. B. Hopkins, 189 Castle Road.

Cardiff Y.M.C.A. Camera Club.—(ESTABLISHED 1895.) Meetings held at the Y.M.C.A., Queen Street, Cardiff. *President*—J. Thompson Willows, L.D.S., R.C.S. *Vice-Presidents*—Dr. De Vere Hunt, F.R.M.S., R. Cory, J.P., Jesse Williams, M.P.S. *Committee*—C. W. Thompson, L. J. Burch, W. Watts, W. C. Cooper, R. James. *Treasurer*—G. P. H. Buston. *Secretary*—J. E. Blackburne, 136 Cathedral Road, Cardiff.

Carlisle and County Amateur Photographic Society.—(ESTABLISHED 1885.)—Meetings are held at the Y.M.C.A. Hall, Fisher Street, Carlisle. *President*—K. J. Hough. *Vice-Presidents*—J. Beaty, L. Carr, Rev. Canon Bower. *Committee*—R. M. Hill, — Jack, R. M. Thompson, W. F. Bell, J. A. Halhead, Dr. MacLaren. *Treasurer*—John Robson. *Secretary*—D. Hodgson, The Hollins, Newby (West), Carlisle.

Cheltenham Amateur Photographic Society.—(ESTABLISHED 1865.)—Meetings held at the College Pharmacy, Bath Road, Cheltenham. *President*—General F. Dawson, C.B. *Vice-President*—W. Beetham. *Secretary*—Philip Thomas, College Pharmacy, Bath Road, Cheltenham.

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Chester Society of Natural Science, Literature, and Art (Photographic Section).—(ESTABLISHED 1887.)—Meetings held at the Grosvenor Museum, Chester. *Chairman of Section*—Dr. Stolterforth, M.A., J.P. *Council*—Lieut.-Colonel Dowdall, E. G. Ballard, A.R.S.M., F. Garside, A. E. Goodman, A. Lamont, jun., F. W. Longbottom, J. A. McMichael, B.A., B.Sc., W. F. J. Shepheard, F.C.S., C. T. F. Watts, B.Sc. *Secretary and Treasurer*—J. H. Spencer, 36 Bridge Street, Chester.

Chichester Photographic Society.—(ESTABLISHED 1893.)—Meetings held at the Technical Schools. *President*—Dr. E. H. Buckell. *Vice-Presidents*—Dr. Andrè, Rev. J. Henderson, C. Keay, Colonel Lysaght, F.R.P.S., F. B. Tompkins, G. Woodbridge, J.P. *Committee*—R. W. Dawtrey, A. S. Garland, J. Huskinson, Sergeant Todd, T. H. Vinall, H. G. Wildman. *Treasurer*—J. W. Barnes. *Secretary*—G. M. Turnbull, Lyndhurst Lodge, Lyndhurst Road, Chichester.

Chiswick Camera Club.—(ESTABLISHED 1895.)—Meetings are held at the Congregational Lecture Hall, Chiswick. *President*—Herbert Gentry. *Vice-Presidents*—T. A. Coysh and J. Woodger. *Council*—The above, and T. H. Bishop, G. D. Fowle, H. Hucklebridge, J. Mann, C. J. Preston, E. Styles. *Treasurer*—H. E. Ward. *Secretary*—W. E. Walker, 40 Grange Road, Gunnersbury, W.

Chorley Photographic Society.—(ESTABLISHED 1894.)—Meetings held at the Club Rooms, Devonshire Road, Chorley. *President*—H. N. Whittle. *Vice-Presidents*—John Lawrence, John Stanton, S. Morris, J. T. Brierley, F.S.S., T. Haworth, J. Blackshaw, J. R. Waring, T. Brindle, N. Alker. *Committee*—A. Watson, J. Rawlinson, W. Swarbrick, J. Welch, E. Hill, J. Fletcher, A. J. Buckley, J. Withnell, F. Latham. *Treasurer*—R. Gill. *Secretary*—H. R. Dorning, M.P.S., 8 Pall Mall, Chorley.

City and Guilds, Technical College, Finsbury, Photographic Society.—(ESTABLISHED 1887.)—*President*—Prof. R. Meldola, F.R.S., F.I.C., F.C.S. *Vice-Presidents*—J. Castell-Evans, F.I.C., F. W. Streatfeild, F.I.C., F. Southerden, F.I.C. *Committee*—W. Winter, J. Rattenbury, H. Staynes, W. Higgins. *Hon, Treasurer and Librarian*—T. H. Norris, F.I.C. *Hon. Secretary*—Sydney J. Johnstone, 15 Springfield Road, New Southgate.

City of Belfast Y.M.C.A. Camera Club.—(ESTABLISHED 1889.)—Meetings held at Wellington Place, Belfast. *President*—William Strain. *Vice-Presidents*—A. J. Hogg, E. Bingham, T. F. Bell, W. M. Downing, R. G. Moffatt. J. H. Hamilton. *Committee* — A. George, William McLean, H. Rew, D. J. Hogg, James Busby, D. W. Elliott. *Hon. Treasurer*—J. McCleery. *Hon. Secretaries* — J. McCleery and H. Cochrane, jun., Y. M. C. A., Wellington Place, Belfast.

City of Dublin Y.M.C.A. Camera Club.—(ESTABLISHED 1891.)—Meetings held at 43 Upper Sackville Street, Dublin. *President*—E. MacDowel Cosgrave, M.D. *Vice-Presidents*—Greenwood Pim, M.A., Victor Smyth, J. C. Ruthven, Leonard R. Strangways, M.A., Fred Eason. *Council*—G. A. Parnell, A. E. Campbell, Charles E. Stewart, G. W. Riky, J. Gordon, E. Stevenson, J. A. Ray, R. Poynton. *Ladies' Committee*—Miss Owens, Miss Aston, Miss Carnegie. *Hon. Treasurer*—R. J. Wilkin. *Hon. Secretary*—George M. Roche, Cambridge House, Montpelier Hill, Dublin.

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Cleckheaton Mechanics' Institute Photographic Society.—(Established 1895.)—Meetings held at the Technical School, Brooke Street. *President*—Dr. Farrow. *Vice-Presidents*—A. Rhodes, H. S. Atkinson, E. W. Taylor. *Committee*—J. Drake, A. Smith, G. Stead, F. Slinger, W. Asquith, E. Ellis, Abe. Smith. *Treasurer*—Frank Hirst. *Secretary*—William Drake, 7 Westgate, Cleckheaton.

Cleveland Camera Club.—(Established 1891.)—Meetings are held at the Literary and Philosophical Institution, Corporation Road, Middlesbrough. *President*—Colonel S. A. Sadler, V.D., M.P. *Vice-Presidents*—J. J. Burton, R. Moore, G. D. Winter, Dr. Howell, A. Hutchinson, L. M. Gjers. *Committee*—T. J. Kedward, A. G. Hood, H. W. Hood, T. Mistledene, T. W. Windross, A. W. Simons. *Secretary and Treasurer*—Fred. W. Pearson, 98 Victoria Road, Middlesbrough.

Colne Camera Club.—(Established 1892.)—Meetings held at the Cloth Hall, Colne. *President*—Rev. T. Leyland. *Vice-Presidents*—J. Duckworth, J. Hey, Alderman R. Foulds, Councillor H. Holgate, Councillor H. Hewitt, E. Christian, A. P. Threlfall, R. T. Lawson. *Treasurer*—W. J. Robinson. *Secretary*—E. A. Spiney, 27 Calder Street, Colne, Lancashire.

Cornish Camera Club.—(Established 1888.)—Meetings held at the Studio, Park Corner, Penzance. *President*—W. E. Baily, F.L.S., C.C. *Vice-President*—R. Pearce Couch. *Committee*—J. Branwell, jun., C. J. Mabbott, W. Bailey, J. Caldwell, jun. *Treasurer*—Arthur G. Pool. *Secretary*—H. Tonkin, 22 Market Place, Penzance.

Cornwall Central Photographic Club.—(Established 1900.)—Meetings are held at the Central Technical Schools, Truro. *President*—Professor James Clark. *Committee*—Professor Clark, W. A. Rollason, T. G. Martyn, E. H. Davison, F. J. Boundy, A. W. Gill, W. Lidgey. *Secretary and Treasurer*—Alec Gregg, Central Technical Schools, Truro.

Coventry Photographic Club.—(Established 1883.)—Meetings are held at 7 Little Park Street, Coventry. *President*—H. D. Waters. *Vice-Presidents*—Messrs. Seymour, Bates, Goodwin, and Riley. *Committee*—Messrs. McLauchlan, Barry, Danks, and Towell. *Treasurer*—H. D. Waters. *Secretary*—Frank E. Peirson, 1 Barrs Hill, Coventry.

Cripplegate Photographic Society.—(Established 1899.)—Meetings are held at the Cripplegate Institute, Golden Lane, E.C. *President*—The Chairman of the Cripplegate Foundation. *Vice-Presidents*—The Governors of the Cripplegate Foundation. *Committee*—G. Pitt-Smith (Chairman), H. Clarke, G. H. Depledge, F. H. Dowdell, J. C. Holloway, A. B. Moss, H. V. Smith. *Treasurer*—H. G. Stollard. *Secretary*—Alfred T. Ward, Cripplegate Institute, Golden Lane, E.C.

Croydon Microscopical and Natural History Club (Photographic Section).—(Established 1870.)—Meetings are held at the Public Hall, Croydon. *President*—James Epps, jun. *Vice-Presidents*—John Berney, F.R.M.S., H. S. Eaton, M.A., H. T. Mennell, F.L.S., H. G. Thompson, M.D., J.P., &c., Edward Lovett, H. F. Parsons, M.D., F.G.S., W. Murton Holmes. *Committee*—J. H. Baldock, F.C.S. (Lanternist and Recorder), A. Roods (Librarian), C. J. L. Russell, A. J. Weightman, R. F. Grundy. *Treasurer*—F. J. Townend. *Secretary*—E. Pierce, Public Hall, Croydon.

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Darwen Photographic Association.—(Established 1894.)—Meetings held at the Belgrave Schools, Darwen. *President*—George Butterworth. *Vice-Presidents*—Councillor Ralph Shorrock, Dr. Haworth, Dr. DuCane, Robert Gillibrand, J.P., James E. Cooper, J. F. Leach, Dr. Steele, J. W. Smith. *Council*—R. H. Duckworth, R. Ibbotson, James Cook, Richard Holden, Albert Almond, James Cavis, John Cooper, John Wild, Robert Preston, John Cross. *Librarian*—William Walsh. *Lanternists*—Messrs. Butterworth and Holden. *Hon. Treasurer*—F. J. Nuttall. *Survey Secretary*—J. W. Smith. *Hon. Secretary*—J. G. Thomas, Fern Cottage, Sough Road, Darwen.

Derby Photographic Society.—(Established 1884.)—Meetings held at the Grand Jury Room, Town Hall, Derby. *Patron*—Sir W. de W. Abney, C.B., D.C.L., F.R.S., F.R.A.S. *President*—C. Barrow Keene, F.R.P.S. *Vice-President*—Bendle Moore. *Committee*—C. Bourdin, G. Cornwell, H. G. W. Dawson, H. Frost, J. Fleet, S. Finney, F. Smithard, F. Willatt, G. Walker. *Treasurer*—F. H. Gandy. *Secretary*—F. G. Smith, Friary House, Uttoxeter, New Road, Derby.

Devonport Camera Club.—(Established 1891.)—Meetings are held at the Devonport Technical Schools. *President*—H. J. Hissett. *Vice-Presidents*—J. T. Trend, C. Dart, W. H. Lethbridge, W. G. Parkman. *Committee*—G. H. Cripps, W. H. Mayne, R. Maw, R. O. Joliffe. *Treasurer*—A. J. Catford. *Secretary*—F. B. Langdon, 19 Trafalgar Place, Stoke, Devonport.

Doncaster Camera Club.—*President*—E. Gledhill. *Vice-Presidents*—Messrs. Girdlestone and Buckley. *Committee*—H. Emblow, W. H. White, W. Yates, H. W. Cornelius, and F. Moat. *Auditor*—H. Waterton. *Hon. Secretary*—E. E. Burgess, Station Road, Doncaster. *Assistant Hon. Secretary and Treasurer*—T. H. Connor, jun.

Dorset Amateur Photographic Association.—(Established 1886.)—Meetings are held at various places in the county. *President*—Rev. W. M. Barnes. *Committee*—Hermann Lea, R. W. Copeman, A. D. Moullin. *Secretary and Treasurer*—Rev. T. Perkins, Turnworth Rectory, Blandford.

Dover Photographic Society.—(Established 1896.)—Meetings are held at Dover. *President*—Rev. Tuberville Evans. *Committee*—Captain Gordon McDakin, Mowbray Gray, H. Peake, J. J. Goulden. *Treasurer*—R. M. Ewell. *Secretary*—Lieut.-Colonel J. G. Cockburn Curtis, 21 Leyburne Terrace, Dover.

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Dukinfield Photographic Society.—(ESTABLISHED 1888.)—Meetings held at the Co-operative Hall, Dukinfield. *President*—Thomas Hodgetts Gordon, B.A., C.C. *Vice-Presidents*—Messrs. Ainsworth, J. W. Hadfield, Winterbottom, and Thompson. *Council*—T. H. Gordon, B.A., C.C., S. Ainsworth, P. Rigby, J. W. Andrew, J. W. Hadfield, F. Thompson, J. Gill, Henry Rowland. *Librarian*—Leon J. Scott. *Treasurer*—Henry L. Hadfield. *Secretary*—D. Firth, Hall Green, Dukinfield.

'Dundee Advertiser' Photographic Club.—(ESTABLISHED 1894.)—Meetings held at *Dundee Advertiser* Office, Dundee. *President*—J. L. Scott. *Vice-President*—W. G. Swan. *Committee*—William C. Clark J. A. Mackenzie, John Macrae. *Secretary and Treasurer*—Archibald Campbell, Stewart Terrace, Barnhill, Broughty Ferry, N.B.

Dundee and East of Scotland Photographic Association.—(ESTABLISHED 1879.)—Meetings held at University College, Dundee. Club Room, 39 High Street, Dundee. *President*—W. F. Hill. *Vice-Presidents*—W. H. Tittensor and W. Salmond. *Council.*—J. S. Lawson, A. Macdiarmid, J. Ogilvie, J. Peebles, D. Ireland, O. B. Hatch, Professor Steggall, Dr. Tulloch, W. Bertie, A. Campbell, G. D. Macdougald, G. Worrall. *Secretary and Treasurer*—V. C. Baird, Broughty Ferry, N.B.

Durham City Camera Club.—(ESTABLISHED 1892.)—Meetings held at the Shakespeare Hall, Durham. *President*—Major E. White. *Vice-Presidents*—E. Meynell, W. Moult, J. F. Hobson. *Committee*—J. Booth, F. Cluff, T. Harker, J. Morson. *Treasurer*—W. Gray. *Secretary*—Robert Hauxwell, The Avenue, Durham.

Ealing Photographic Society.—(ESTABLISHED 1890.)—Affiliated with the Royal Photographic Society. Meetings held at the Public Buildings, Ealing. *President*—W. T. White. *Vice-Presidents*—C. Jones, C.E., T. Simpson, R. Y. Murphy *Council*—H. A. Ball, G. Fryer, H. C. Lambert, G. W. Pearce, S. Stewart, J. Watson. *Hon. Curator, Lanternist, and Librarian*—A. Richardson. *Hon. Treasurer*—A. F. Taylor. *Hon. Secretary*—R. M. Dawson, 115 Gordon Road, Ealing, W.

Eastbourne Photographic Society.—(ESTABLISHED 1892.)—Meetings held at the Caldecott Museum Building, Lismore Road. *President*—Henry Habgood, M.D. *Vice-Presidents*—T. Macqueen, H. M. Whitley, Major Molineux. *Committee*—J. Coster, E. Kelsey, G. D. Romer, M. Phillips, J. C. Wright, J. Ellmore, H. Sparks, W. Sparrow. *Secretary and Treasurer*—J. J. Hollway, Glengariff, Willingdon Road, Eastbourne.

Eccles Photographic Society.—(ESTABLISHED 1899.)—Meetings are held at 18 Peel Street, Eccles. *President*—Penry Williams. *Vice-Presidents*—Edmund Johnson and Herbert Cottrill. *Committee*—J. Dale, R. Fletcher, T. Hughes, W. Hulme, J. P. Jackson, D. Lawton, F. Smith. *Treasurer*—W. I. Scholes. *Secretary*—A. Atkinson, Riversdale, The Grove, Eccles.

Edinburgh Photographic Club.—(ESTABLISHED 1881.)—Meetings are held at 38 Castle Street, Edinburgh. *President*—James B. Johnstone. *Committee*—James B. Johnstone, T. Barclay, George Cleland. *Treasurer*—George Cleland. *Secretary*—T. Barclay, 180 Dalkeith Road, Edinburgh.

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Edinburgh Photographic Society.—(ESTABLISHED 1861.)—Meetings held at 38 Castle Street, Edinburgh. *President*—James Burns. *Vice-Presidents*—J. B. Johnston and David McArthy. *Council*—H. Scott Lauder, Dep. Insp. Gen. R.N., R. H. McBean, H. Stewart Wallace, W.S., Frank C. Inglis, J. Tudor Cundall, B.Sc., John Mackintosh, Joseph C. Lennie, F. P. Moffat, James Craig, R. S. Webster, James Murdoch, W. J. Crear. *Curator*—John Anderson. *Treasurer*—George Cleland. *Secretary*—J. S. M‘Culloch, W.S., 10A George Street, Edinburgh.

Everton Camera Club.—(ESTABLISHED 1896.)—Meetings held at 10 Albion Street, Everton. *President*—Thomas Sanderson. *Vice-Presidents*—J. Mansell and E. Youds. *Council*—C. W. Childs, R. Clark, W. Tansley, C. B. Stonehouse, D. Young, J. Hawkins. *Treasurer*—F. Walker. *Secretary*—Charles R. Pearson, 5 Breck Grove, Everton.

'Exchange' Postal Negative Club.—(ESTABLISHED 1888.)—*Secretary and Treasurer*—G. F. Gregor-Grant, Aviemore, Lucien Road, Tooting Bec Common, London, S.W.

Exeter Camera Club.—(ESTABLISHED 1890.)—Meetings are held at Barnfield House, Exeter. *President*—J. W. Huggins. *Vice-Presidents*—Rev. J. Sparshalt, M.A., C. Cole, W. Lloyd Jones. *Council*—A. E. Berg, R. C. Cole, F. Green, T. A. Goard, J. W. Lake, E. Pocknell, F. Conway Sharp. *Treasurer*—J. Hinton Lake. *Secretary*—Cecil R. M. Clapp, M.A., L.S.M., Barnfield House, Exeter.

Exeter Hall Photographic Society.—(ESTABLISHED 1898.)—Meetings held at Exeter Hall, Strand, W.C. *President*—Rev. F. C. Lambert, M.A. *Vice-Presidents*—H. Conder, John H. Putterill, W. H. Smith, W. Wilson Hind-Smith, F.R.G.S. *Committee*—R. W. Clarke, H. Grace, W. Green, John W. Hobday, F. R. Rose. *Hon. Editor*—C. G. Paul. *Captain Cycling Section*—E. Lutman. *Hon. Treasurer*—J. H. Butler. *Hon. Secretary*—W. E. Longhurst, Lightfoot House, Hornsey, N.

Fakenham Literary, Field, and Camera Club.—(Established 1892 as Fakenham District Camera Club, Extended and Reorganised 1900 as Fakenham Literary, Field, and Camera Club.)—Meetings held at the Club Rooms, Norwich Street, Fakenham, Norfolk. *President*—Algernon Digby, M.A. *Vice-Presidents*—Rev. Canon Humphreys, M.A., Rev. W. Martin, B.A., Rev. J. Lee Warner, M.A., Thomas Charlton, Dr. W. H. Fisher, Dr. F. L. Pochin. *Committee*—Dr. F. L. Pochin (Chairman), Joseph Baker, C. J. Elliott, H. J. Heyhoe, T. J. Miller, jun., W. O. Miller, T. E. Pengelley, J. Wainwright, J. W. Woolhouse. *Secretary and Treasurer*—Henry Newson, The Square, Fakenham, Norfolk.

Falkirk Amateur Photographic Association.—(ESTABLISHED 1889.)—Meetings held at Newmarket Street. *President*—George Sherriff. *Vice-Presidents*—John Higgins and William Hamilton. *Committee*—H. Johnstone, John Wilson, John Bellingham, J. Harley, F. Currie, William P. Crosbie. *Treasurer*—Robert Sinclair. *Secretary*—William C. Murray, Arnothill Gardens, Falkirk.

Fylde Amateur Photographic Society.—(ESTABLISHED 1895.)—Meetings held at Blower's Restaurant, South Shore, Blackpool. *President*—Dr. Vinter. *Committee*—G. H. Holmes, J. Turnbull, J. J. Fleming. *Treasurer*—L. Harrison. *Secretary*—J. Smith, 22 Dean Street, South Shore, Blackpool.

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Glasgow and West of Scotland Amateur Photographic Association.—(ESTABLISHED 1883.)—Meetings held at 180 West Regent Street, Glasgow. *President*—George Watson, B.A. *Vice-President*—Andrew Brown. *Council*—T. W. Robertson, T. Wishart, J. W. Downs, P. Falconer, James Baillie, A. Ralston, J. C. Oliver, G. Chalmers, J. W. Reoch, J. I. Fraser, A. J. Kay, N. G. Reed. *Treasurer*—W. J. B. Halley. *Secretary*—William Goodwin, 3 Lynedoch Street, Glasgow.

Glasgow Camera Club.—(ESTABLISHED 1895.)—Meetings are held at the Religious Institution Rooms, Buchanan Street, Glasgow. *President*—James Gray. *Vice-President*—R. Young. *Committee*—Messrs. Davidson, McIntyre, Muirhead, French, Gordon, and Saunders. *Lanternist*—R. Gray. *Treasurer*—G. R. Bryce. *Secretary*—Cecil H. Burr, 3 Berlin Place, Pollokshields, Glasgow.

Glasgow Eastern Amateur Photographic Association.—(ESTABLISHED 1897.)—Rooms, 12½ Landressy Street, Bridgeton, Glasgow. *Hon. Members*—James Templeton, John Tullis, Charles Scott Dickson, M.P. *Hon. Presidents*—George H. Laird and W. R. Malcolm. *President*—Alexander D. Inglis. *Vice-Presidents*—Robert M'Millan and James Kennedy. *Council*—Matthew Crosbie, Matthew Wilson, John Gardner, Alexander Allan, jun , W. S. Crocket, D. Johnston. *Lanternist*—John Gillespie. *Treasurer*—Alexander M'Intyre. *Secretary*—George R. Johnstone, 166 Slatefield Street.

Glasgow Photographic Association.—(ESTABLISHED 1862.)—Meetings held at the Philosophical Society's Rooms. *President*—John Stuart. *Vice-Presidents*—J. Craig Annan and William Lang, F.C.S.. *Council*—Robert Dodd, J. E. Hanbidge, George Mason, A. Lindsay Miller, J. C. Oliver, Archd. Watson. *Treasurer*—George Bell. *Secretary*—Charles Macdonald, 100 West Regent Street, Glasgow.

Glasgow Southern Photographic Association.—Meetings are held every Tuesday evening at eight, in Room No. 3, Y.M.C.A. Buildings, Eglington Toll, Southside, Glasgow. *President*—David Horn. *Vice-President*—Robert Ballantyne, jun. *Council*—Robert Gracie, William Morrison, Robert Aitchison, David Linton, William N. Fraser, John Mathie, jun. *Hon. Secretary and Treasurer*—John B. Haggart, 93 Norfolk Street, Glasgow. *Assistant Secretary*—Robert Lindsay, 189 Allison Street, Govanhill, Glasgow.

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Glossop Y.M.C.A. Photographic Club.—Meetings are held at the Y.M.C.A. Rooms, Victoria Street. *Hon. Secretary*—T. W. Sharpe, 14 Hollin Cross Lane, Glossop.

Goldsmiths' Institute Camera Club.—(Established 1893.)—Meetings held at the Goldsmiths' Institute, New Cross, London, S.E. *President*—J. W. Penfold. *Vice-Presidents*—W. G. Hodge, Dr. Lapworth, W. J. Pope, W. T. Wilkinson. *Committee*—Miss E. Beattie, Miss A. Harman, T. P. Rogers, A. L. Henderson, H. W. Mayo, J. Turner. *Treasurer*—W. Jacob. *Joint Secretaries*—C. B. Storey and A. H. Downey. *Ladies' Secretary*—Miss D. H. Tuppen, Goldsmiths' Institute, New Cross, S.E.

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Gravesend and District Photographic Society.—(Established 1900.)—Meetings held at the Medical Hall Rooms. *President*—Charles W. Hastings. *Vice-Presidents*—Rev. E. Most, M.A., J. C. Johnson, J.P., G. M. Arnold, J.P., Captain Williams. *Council*—Rev. G. N. Banks, A. Carpenter, F. T. Grant, A. A. Gillitt, J. A. Mitchell, A. E. Pickering, J. T. Simmons, P. Terry. *Treasurer*—J. H. Cooper. *Secretaries*—T. L. Winnett, 5 The Grove, Gravesend, and W. May, 3 St. John's Road, Gravesend.

Greenock Camera Club.—(Established 1888.)—*President*—James Wright. *Vice-President*—Robert Tough, jun. *Council*—The Officers and John C. Fisher, Frank Macdonald, A. Bathgate, A. McVicar Mrs. Fleming, Miss McCallum, George Dunlop, G. T. Poulter, R. W. Jamieson, W. Morrison. *Lanternist*—Richard Jones. *Treasurer*—William James. *Secretary*—W. D. Boyd, 4 Argyle Street. *Assistant Secretary*—Thomas Low, 45 Brisbane Street.

Grimsby and District Photographic Society.—(Established 1894.)—Meetings held at Victoria Street, Grimsby. *President*—J. Sutcliffe, J.P. *Vice-Presidents*—R. C. Long and W. B. Simpson, M.B. *Committee*—W. C. Butler, W. J. Brumpton, H. Dodds, J. H. Clayton, W. Daddy, A. L. Kershaw, A. T. Flint, J. Wharton, G. E. Collins, C. Dewing. *Librarian*—D. Fountain. *Treasurer*—Dr. A. Westlake. *Secretary*—A. E. Matthews, 59 Ainslie Street Grimsby.

Guildford Photographic Society.—(Established 1900.)—Meetings held at the Institute, Ward Street, Guildford. *President*—The Right Hon. the Earl of Onslow, G.C.M.G. *Vice-Presidents*—G. J. Jacobs, R. W. Robinson, J. Russell, F. Wheeler. *Committee*—E. W. Bradden, A. W. Bullen, H. M. Moon, W. T. Patrick, W. R. Philpot, H. C. Reid. *Treasurer*—J. H. Nunn. *Secretary*—A. E. Moon, 3 Sydney Terrace, Sydney Road, Guildford.

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Hackney Photographic Society.—(ESTABLISHED 1889.)—Meetings held at the Pembury Hotel, Amhurst Road, Hackney, N.E. *President*—Councillor E. Farmer. *Council*—Dr. Burton, A. W. Cook, W. Fenton-Jones, F. W. Gosling, H. W. Lane, W. Rawlings, J. J. Westcott, L. S. Wilks, S. C. Stean (Excursion Secretary), G. Parks (Librarian), H. W. Dunkley (Lanternist). *Treasurer*—W. L. Barker. *Secretary*—Walter Selfe, 70 Paragon Road, Hackney, N.E. *Assistant Secretary*—A. D. Fort.

Halifax Camera Club.—(REORGANIZED 1895.)—Meetings held at 29 Northgate, Halifax. *President*—J. Ingham Learoyd. *Vice-Presidents*—J. W. Holland, G. H. Hodgson, T. Illingworth, H. Mortimer, J. W. Pilling, A. Priestley, C. Thomas, C. Rhodes, G. R. Ryley. *Committee*—E. Crowther, C. Foster, E. Knapton, E. Laughton, J. H. Hanson, F. Armstrong, H. Kitson, W. Bonner, R. Embleton. *Secretary and Treasurer*—Lionel Dickinson, 3 Livingstone Street, Lee Mount, Halifax.

Haltwhistle and District Photographic Society.—(ESTABLISHED 1889.)—Meetings are held at Haltwhistle. *President*—Dr. W. R. Speirs. *Vice-President*—Major Anne. *Secretary and Treasurer*—David Macadam, London City and District Bank, Haltwhistle.

Hand Camera Portfolio Club.—(ESTABLISHED 1898.)—A Postal Club devoted to Hand Camera work. *Hon. Secretary*—Surgeon-Major Adcock, M.D., 1 Queen's Parade, Bath.

Hand Camera Postal Club.—(ESTABLISHED 1897.)—Advanced workers of the hand camera only eligible for membership. Specimens of work should accompany all applications for membership. *Secretary and Treasurer*—George V. Myatt, Mount Pleasant House, Leek, Staffordshire.

Handsworth Photographic Society.—(ESTABLISHED 1894.)—Meetings held 111 Soho Road (Y.M.C.A. Rooms), Handsworth, Birmingham. *President*—Philip Whitehouse. *Vice-Presidents*—W. J. Foster, L.R.C.P., E. F. Freeland, C. F. Jarvis, W. J. Morgan. *Council*—G. Allen, J. H. Brindley, E. Marlow, G. Owen, F. Smith, C. L. Stait, G. Thompson, E. Ward. *Hon. Lanternist*—C. P. Proctor. *Hon. Librarian*—J. W. Baker. *Hon. Auditors*—H. B. Pickering and G. A. Fisher. *Hon. Treasurer*—W. J. Bore. *Hon. Secretary of Survey Section*—W. J. Morgan, One Oak, Radnor Road. *Hon. Secretary*—A. E. Teague, 51 Linwood Road.

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Highbury Quadrant Scientific and Photographic Society.—(Established 1900.)—Meetings held at the Highbury Quadrant Hall. *President*—Rev. W. J. Dawson. *Vice-Presidents*—Miss Isabel A. Newton, B.A., J. W. Brigstock, William Cook, H. Graddon. *Committee*—Miss L. Hunt, Miss Komlosy, J. H. Bolton, R. H. Glassock, A. H. Parsons, J. H. S. Walker, G. H. Worster. *Hon. Treasurer*—A. E. Birch. *Hon. Secretary*—T. L. Hughes, 58 Highbury Hill, N.

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Hove Camera Club.—(Established 1891.)—Meetings held at the Town Hall, Hove. *President*—Alderman J. Colman, J.P. (Mayor of Hove). *Vice-Presidents*—W. A. Hounsom, J.P., Charles Job, F.R.P.S., E. E. Mainwaring, M.R.C.S.E., L.R.C.P.L., W. Clarkson Wallis, Alderman G. B. Woodruff, J.P. *Committee*—W. A Ford, H. S. Gilkes, D. J. Gadsby, C. Berrington-Stoner. *Hon. Lanternist*—W. A. Ford. *Hon. Secretary*—A. R. Sargeant, 55 The Drive, Hove. *Assistant Hon. Secretary and Treasurer*—R. C. Foskett, 26 Adelaide Crescent, Hove.

Huddersfield Naturalist and Photographic Society.—(Established 1850.)—Meetings are held at the Y.M.C.A., Huddersfield. *President*—Alfred Clarke. *Vice-Presidents*—T. W. Woodhead, F.L.S., and H. G. Brierley. *Committee*—T. H. Bartlam, W. A. Beevers, F. Netherwood, A. Houghton, H. Revell, George Carrie, A. Aspinall, Mrs. H. G. Brierley. *Treasurer*—A. W. Whiteley. *Secretaries*—W. E. L. Wattam, 54 Towngate, Newsome, and W. H. Houghton, King's Mill Lane, Huddersfield.

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Hyde Photographic Association.—Meetings are held at the Club-rooms, Simpson Street, Hyde. *Council*—W. Allan Dew and W. Suelson. *Secretary*—W. H. Middleton, 34 Cross Street, Hyde.

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Idlers' Camera Club.—(ESTABLISHED 1899.)—Meetings held at 12 Freemantle Square. *President*—Charles Harry. *Committee*—G. Mallett, W. V. Collett, E. J. Dyment, E. S. Spurrier, H. W. Hobbert, F. O. Lewis, R. Hulme. *Secretary and Treasurer*—Arthur F. Vizor Collett, 52 Belmont Road, Montpelier, Bristol.

Ipswich Scientific Society (Photographic Section).—(ESTABLISHED 1869.)—Meetings held at the Museum, Ipswich. *President*—W. E. Watkins. *Committee*—J. S. Corder, S. A. Notcutt, B.A., B.Sc., E. P. Ridley, F.G.S., Dr. G. Vincent, J. C. Wiggin, F. Woolnough, G. H. Hewetson, H. Miller. *Treasurer*—H. Miller. *Secretary*—Frank Woolnough, Museum, Ipswich.

Isle of Thanet Photographic Society.—(ESTABLISHED 1888.)—Affiliated to the Royal Photographic Society. Meetings are held at the Club Room, Broad Street, Ramsgate. *President*—Rev. L. J. White Thomson, M.A. *Vice-Presidents*—Rev. C. E. Eastgate, J. H. Forwalk, G. F. Blower, Dr. A. Rowe, Dr. A. D. Griffiths, P. Solly. *Committee*—Messrs. Deacon, Hoile, Savage, Simmers, Vigar, and Weeks. *Hon. Lanternist*—J. H. Forwalk. *Hon. Assistant Lanternist*—E. Deacon. *Delegate to the Royal Photographic Society*—J. C. Goldsack. *Hon. Secretary and Treasurer*—J. C. Goldsack, Llanberis, Grove Road, Ramsgate.

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Keighley and District Photographic Association.—(ESTABLISHED 1889.)—Meetings are held at the Mechanics' Institute, Keighley. *President*—W. Tate. *Vice-Presidents*—Samuel Bairstow, J. G. Dickenson, T. Heaps, Alexander Keighley, G. H. Naylor. *Committee*—J. H. Bentley, John Gill, B. P. Heaton, M. Houghton, E. F. Lever, E. Myers, W. Robertshaw, T. A. Smith. *Treasurer*—W. Mitchell. *Secretaries*—C. H. Smith, 110 Devonshire Street, Keighley, and Frank Gill, 27 Highfield Lane, Keighley.

Kennaway Photographic Society.—*Patron*—The Right Hon. Sir John H. Kennaway, Bart., M.P. *President*—Rev. H. E. Fox. *Hon. Secretary*—William R. C. Cooke, C. M. House, Salisbury Square, London, E.C.

Kent Postal Camera Club.—(ESTABLISHED 1894.)—A circulating monthly portfolio. Limited to twenty advanced workers. *Secretary*—H. T. Brookes, 2 Stanley Street, Lindley, Huddersfield.

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Kilmarnock and Ayrshire Photographic Society.—(Established 1887.)—Meetings held at Kilmarnock. *President*—Robert Boyd. *Vice-President*—J. J. Railton. *Council*—Robert Boyd, J. J. Railton, John Henderson, Thomas Ferguson, Robert Gudgeon, Thomas H. Milloy. *Treasurer*—John Henderson. *Secretary*—Thomas H. Milloy, 15 William Street, Kilmarnock.

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Kingston-on-Thames and District Photographic Society.—(Established 1893.)—Meetings held at the Sun Hotel, Kingston-on-Thames. *President*—Rev. G. I. Swinnerton, M.A. *Vice-Presidents*—Dr. Finny, Albert Hill, Rev. F. C. Lambert, M.A., Dr. Luscombe, Dr. Munyard, W. E. Price, A.M.I.C.E., W. M. Robertson, George Sanders, J.P. *Committee*—H. C. Fox, W. F. J. Hodgson, H. M. C. Sprunt, A. Vandendriesche, T. W. Wilson. *Treasurer*—W. M. Robertson. *Secretary*—John F. East, Uxbridge House, Kingston-on-Thames.

Kirkcaldy Photographic Society.—(Established 1898.)—Meetings held at 196 High Street. *President*—D. Landale. *Vice-President*—A. Harley. *Council*—George Pringle, Alexander Purves, A. B. Young, Hope P. Thomson, D. Storrar, J. G. Hardie. *Treasurer*—Charles Stewart. *Secretary*—S. Stewart, 2 Salisbury Street, Kirkcaldy.

Lancaster Photographic Society.—(Established 1889.)—Meetings held at Stonewell, Lancaster. *President*—Alan Garnett. *Vice-Presidents*—N. Holden and A. S. Barling. *Committee*—W. Clough, J. B. Briggs, W. Sumner, R. W. Wearing, J. W. Pickard, S. Thompson. *Treasurer*—C. D. Baxandall. *Secretary*—W. Briggs. *Assistant Secretary and Librarian*—R. T. Simpson, 21 Cheapside, Lancaster.

Lantern Slide Exchange Club.—(Established 1889.)—*Secretary and Treasurer*—J. S. Hawker, Mutley House, Plymouth.

Leamington Amateur Photographic Society.—(Established 1887.)—Meetings held at the Pump Room, Leamington. *President*—Rev. Edward Healy. *Vice-President*—R. Aspa. *Treasurer*—J. W. Green. *Secretary*—J. Alfred Hill, Normanhurst, Warwick New Road, Leamington.

Leeds Camera Club.—(Established 1893.)—Meetings are held at the White Swan Hotel, Call Lane. *President*—F. Rust. *Vice-Presidents*—W. Emmott, A. Homburg, W. R. Irwin, Major Norwood. *Hon. Members*—R. Child Bayley, R. Bourke, A. Horsley Hinton, W. E. Tindall, R.B.A., W. Thomas. *Committee*—C. H. Allanson, G. Dixon, P. Elliff, T. Gascoigne, I. Howe, T. Ryder, W. Waring. *Lanternist*—H. Wormald. *Treasurer*—J. Skilbeck. *Secretary*—F. G. Issott, 62 Compton Road, Harehills, Leeds.

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Leicester and Leicestershire Photographic Society.—(ESTABLISHED 1885.)—Meetings are held at the Sunday-school Memorial Hall, Leicester. *President*—Thomas Brown. *Vice-President*—R. W. Harvey. *Committee*—G. Bankart, W. Bush, A. Gorrie, E. B. Miles, J. Toone, H. Walker. *Treasurer*—Lewis Ough. *Secretary*—W. Murray, 60 Melton Road, Leicester.

Leicester Literary and Philosophical Society (Photographic Section).—Meetings are held in the Council Room, Town Museum, Princess Street. *Chairman*—H. Alfred Roechling, C.E., F.G.S., &c. *Vice-Chairman*—J. Porritt. *Hon. Secretary*—G. Owston Marshall, Carisbrooke, Victoria Road.

Leigh Photographic Society.—(ESTABLISHED 1892.)—Meetings are held at Market Buildings, Leigh. *President*—Dr. H. S. Hall. *Vice-Presidents*—W. Hampson, R. Leigh, T. Lee Syms, R. B. Mawson, Dr. J. Jones. *Committee*—C. Bruce, J. Berry, W. R. Moore, A. Preston, A. Sims, P. Seddon, J. Smith. *Treasurer*—T. Haddock. *Secretary*—T. Mercer, 2 Clarence Street, Leigh, Lancashire.

Leith Amateur Photographic Association.—(ESTABLISHED 1888.)—Meetings held at 16 Primrose Street, last Tuesday of each month. *Hon. President*—R. Hunter. *President*—A. C. Burge. *Vice-President*—W. Seatter. *Council*—Wilson, Guthrie, Horne. *Auditors*—Gibson and Smith. *Treasurer*—Murdoch Campbell. *Secretary*—William Duncan, Solicitor, 36 Charlotte Street, Leith.

Light and Truth Postal Photographic Club.—(ESTABLISHED 1890.)—*Secretary and Treasurer*—George Harry Haycox, St. Dunstan's Crescent, Worcester.

Lincolnshire Science Society.—(ESTABLISHED 1897.)—Meetings held at the Science and Art Schools, Lincoln. *President*—George M. Lowe, M.D. *Vice-Presidents*—A. E. Collis, M.I.M.E., R. C. Hallowes, A. S. Lester-Melville, Rev. E. Nelson, M.A. *Council*—President, Vice-President, Secretary, Treasurer, and Rev. J. E. Kent, J. W. Horton, W. Le Tall, W. S. Richardson, D. J. G. Watkins, M.B. *Treasurer*—C. W. Witted, *Secretary*—J. Eardley Mason, 34 Chaplin Street, Lincoln.

Liverpool Amateur Photographic Association.—(ESTABLISHED 1863.)—Meetings held at Percy Buildings, Eberle Street, Liverpool. *President*—Dr. Llewellyn Morgan. *Vice-Presidents*—E. Rimbault Dibdin and Joseph Appleby. *Council*—G. E. Newton, Joseph Earp, W. Prior Christian, Henry Lupton, C. F. Depree, Dr. C. Thurstan Holland, Dr. T. W. A. Napier, W. A. Taylor, T. E. Corney Wilson, John H. Welch, F. A. Schierwater, William Harvey, James Parkinson. R. F. Soper, Paul Lange. *Treasurer*—P. H. Phillips. *Secretary*—Edwin Simnett, Percy Buildings, Eberle Street, Liverpool.

Liverpool Central Y.M.C.A. Camera Club.—(ESTABLISHED 1880.)—Meetings held are at Mount Pleasant, Liverpool. *President*—Richard Brown. *Committee*—A. Bryning, George Coleburn, F. O. Cresswell, J. M. Dow, J. Henderson, F. Moreland. *Hon. Secretary and Treasurer*—R. A. Croston, 44 Osborne Road, Tuebrook, Liverpool.

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Liverpool University College Chemical Society.—(Established 1893.)—Meetings held at the Chemical Laboratories, Brownlow Street, Liverpool. *President*—J. F. Spencer, B.Sc. *Committee*—J. H. Reid, J. McConnan, E. G. Jones. *Secretary and Treasurer*—A. Rule, B.Sc., University College, Liverpool.

Llandudno Camera Club and Lantern Society.—(Established 1892.)—*President*—Lord Mostyn. *Hon. Secretary*—A. Ernest Deacon, Gloddaeth Street, Llandudno.

London and Provincial Photographic Association.—(Established 1882.)—Meetings are held at the White Swan Hotel, Tudor Street, London, E.C. *Trustees*—A. Haddon and Thomas E. Freshwater. *Committee*—R. Beckett, R. P. Drage, T. K. Grand, J. E. Hodd, J. W. Hodges, R. J. Kindon, H. C. Rapson, J. S. Teape. *Curator and Lanternist*—S. Heskins. *Recorder*—E. Featherstone. *Librarian*—E. T. Wright. *Hon. Secretary and Treasurer*—Walter D. Welford, Warwick Lodge, 166 Romford Road, London, E.

Longton and District Photographic Society.—(Established 1894.)—Meetings held at the Sutherland Institute, Longton. *President*—A. Parkes, J.P., M.R.C.S., L.R.C.P. *Vice-Presidents*—E. Hallam and A. W. Allin. *Committee*—J. Bold, J. T. Mountford, G. V. Myatt, S. Jackson, W. Bates, J. O. Price, F. Chapman. *Treasurer*—S. Ashcroft. *Secretary*—Thomas Mottershead, 43 Stafford Street, Longton, Staffordshire.

Loughborough Amateur Photographic Society.—(Established 1888.)—Meetings are held at Devonshire Square. *President*—Alderman W. C. Burder, J.P. *Secretaries*—P. W. Crane, 105 Toothill Road, Loughborough; and William Clarke.

Louth and District Photographic Society.—(Established 1890.)—Meetings held at 8 Upgate, Louth, Lincolnshire. *President*—Rev. J. Edward Standen, M.A. *Vice-President*—F. J. Ingoldby. *Committee*—S. F. Clarke, O. Burditt, W. Shephard, A. Ingoldby, G. Godsmark, A. Plaskitt. *Treasurer*—H. S. Forman. *Secretary (acting)*—Rev. J. Edward Standen, M.A., 4 South Street Louth, Lincolnshire.

Ludlow Photographic Society.—(Established 1897.)—Meetings are held at Butter Cross, Ludlow. *President*—Willoughby Hurt Sitwell. *Vice-Presidents*—Lord Inchiquin, Edward Wood, C. A. Rouse Boughton Knight, W. St. A. Rouse Boughton, Sir C. H. Rouse Boughton, Bart., A. J. Rouse Boughton Knight. *Committee*—Tilsley Price, J. H. Suttle, W. H. Bessell, G. E. Davis, J. H. Williams. *Treasurer*—George E. Davis. *Secretary*—Tilsley Price, Gravel Hill, Ludlow.

Luton Camera Club.—(Established 1898).—Meetings are held at 72 George Street, Luton. *President*—W. Dandy. *Vice-Presidents*—H. E. Cocker and J. Bond. *Council*—T. Cheeseman, — Eads, W. J. Cooke, W. T. Day. *Treasurer*—J. L. Bailey. *Secretary*—Edward J. Bradley, 4 Collingdon Street, Luton.

Lyonsdown Amateur Photographic Association.—(Established 1886.)—Meetings are held at different members' houses in turn. *Permanent Chairman*—A. Bentley. *Hon. Treasurer*—Walter Crosbie. *Hon. Secretary*—Frank J. Martin, Northdene, Station Road New Barnet, Herts.

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Manchester Amateur Photographic Society.—(ESTABLISHED 1885.)—Monthly meetings held at the Manchester Athenæum. *President*—Rev. Henry W. Dick. *Vice-Presidents*—S. L. Coulthurst, G. E. Mellor, J. W. Wade, George H. B. Wheeler. *General Committee*—W. H. Bowman, T. Morley Brook, F. W. Burton, J. Collinge, Frederick W. Cooper, J. W. Price P. Rowe, L. Scholes, James Shaw, J. Wood Smith, G. T. White, J. W. Young. *Sub-Committees*—Record: W. H. Bowman, Frederick W. Cooper, G. E. Mellor, J. Wood Smith, P. Rowe (Hon. Secretary); Demonstrations and Rooms: J. Collinge, James Shaw, J. W. Wade, George H. B. Wheeler, S. L. Coulthurst (Hon. Secretary); Lantern: W. H. Bowman, Frederick W. Cooper, J. W. Price, L. Scholes, F. W. Burton (Hon. Secretary); Postal Club: G. T. White and J. W. Price (Hon. Secretary). The President and Secretary are *ex officio* members of all Sub-Committees. *Librarian*—J. W. Young. *Editor of Magazine*—J. Wood Smith. *Hon. Treasurer*—Charles Dawson. *Secretary*—F. W. Parrott, 3 Elm Road, Altrincham.

Manchester Camera Club.—(ESTABLISHED 1883.)—*Committee*—W. A. Hepburn, F. T. Overmann, J. W. Wade. *Treasurer*—J. Davenport. *Secretary*—C. Dawson, 10 Chepstow Street, Manchester.

Manchester Photographic Society.—(ESTABLISHED 1855.)—Meetings held at the Chamber of Commerce Rooms, 44 Mosley Street, Manchester. *President*—Hermann Woolley. *Vice-Presidents*—Abel Heywood, W. B. Wood, J. Whittaker. *Council*—B. J. Beckton, J. G. Chapman, T. Chilton, W. Galloway, W. Rivers, W. E. Wood. *Treasurer*—W. G. Coote. *Secretary*—C. H. Coote, 10 Holmefield, Sale, near Manchester.

Manchester Y.M.C.A. Photographic Club.—(ESTABLISHED 1890.)—Meetings held at the Y.M.C.A., 56 Peter Street, Manchester. *President*—W. H. Machin. *Vice-Presidents*—A. C. Harrison, G. T. White, W. H. Cheetham. *Committee*—George Dixon, W. Crompton, W. Robinson, J. D'Ewart, S. Fordsmith, A. T. Howarth, B. Bailey. *Treasurer*—J. D. Birchall. *Secretary*—John W. Price, 56 Peter Street, Manchester.

Mansfield and District Amateur Photographic Club.—(ESTABLISHED 1896.)—Meetings are held at the Oriental Café. *President*—Alderman Patterson. *Committee*—Miss Jackson, Miss Heane, Messrs. Walkerdine, Bradwell, L. Meggitt, A. Buxton, and H. Pye. *Lanternist*—J. A. Pegg. *Treasurer*—H. Alcock. *Secretary*—Alfred Adlington, Westfield Lane, Mansfield.

Margate Cycling and Camera Club.—(ESTABLISHED 1892.)—Meetings held at the Britannia Hotel. *President*—George Cousins. *Treasurer*—Alfred Henry Markey. *Secretary*—Arthur Hobday, Flint House, Trinity Square, Margate.

Mid-Cheshire Society of Art.—(ESTABLISHED 1895.)—Meetings are held at the Society's Rooms, Castle, Northwich. *President*—Thomas Arthur Johnson. *Committee*—George B. Cliff, J.P., J. Hardie, H. J. Reid, E. P. Ward, H. Yeomans. *Treasurer*—George Holland. *Secretaries*—George Holland, 17 Moss Road, Northwich; Alfred R. E. Lewty, Castle, Northwich.

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Midlothian Camera Club.—(ESTABLISHED 1889.)—Business conducted by means of portfolio. *President*—Dr. W. Stewart. *Vice-President*—Archibald Wilson. *Treasurer*—Robert C. Ewart. *Secretary*—Thomas Wilson, 69 Trafalgar Lane, Leith.

Monklands Photographic Society.—(ESTABLISHED 1893.)—Meetings held at the Club Room, Victoria Place, Airdrie. *President*—Thomas A. Macfarlane. *Vice-President*—Thomas A. Deas. *Committee*—John W. Eadie, W. B. Hossack, Thomas F. Andrew, James Jack, J. Hugginson. *Treasurer*—James S. Lewis. *Secretary*—William Dixon Gray, Stanfield, Airdrie.

Nantwich Camera Club.—(ESTABLISHED 1899.)—Meetings held in the Club Room, 97 Welch Row. *President*—George Crossley. *Vice-President*—C. Kitchen. *Committee*—W. Lloyd, P. Macgowan, B. Arthan. *Secretary and Treasurer*—P. Rawson, 97 Welch Row, Nantwich.

National Photographic Record Association.—(ESTABLISHED 1897.)—Meetings held at 66 Russell Square. *President*—Sir J. Benjamin Stone, M.P. *Council*—Right Hon. the Earl of Crawford, K.T., Sir E. Maunde Thompson, K.C.B., D.C.L., Sir H. T. Wood, M.A., Harold Baker, C. E. Fagan, L. Fletcher, F.R.S., A. Horsley Hinton, St. John Hope, A. V. Haslam, B. E. Lawrence, LL.D., A. Mackie, J. W. Marchant, G. A. T. Middleton, Dr. H. R. Mill, R. Nevill, F.S.A., P. Norman, F.S.A., R. Stone, J. Thomson, Snowden Ward, F.R.P.S., Mrs. Catherine Weid Ward, F.R.P.S., H. B. Weatley. *Treasurer*—Alexander Graham, F.S.A. *Hon. Secretary*—George Scamell, 21 Avenue Road, Highgate, London.

Newcastle-on-Tyne and Northern Counties' Photographic Association.—(ESTABLISHED 1881.)—Meetings are held at the Y.M.C.A., Newcastle-on-Tyne. *President*—J. S. B. Bell, C.E. *Vice-Presidents*—C. E. Barcas, Walter Corder, J.P., W. E. Cowan, J. P. Gibson. *Council*—G. B. Bainbridge, J.P., James Baty, Dr. Blacklock, T. M. Clague, W. Datchin, A. B. Gardiner, W. Parry, Walter Scutt, William Thompson, John Watson. *Lanternists*—J. J. Kirkwood and E. G. Lee. *Treasurer*—Alexander Marshall. *Secretary*—Godfrey Hastings, Station Road, Whitley, Northumberland. *Assistant Secretary*—Thomas Bulman.

Newton Heath Camera Club.—(ESTABLISHED 1894.)—Meetings held at the Newton Heath Wesleyan School. *President*—W. Knowles. *Vice-Presidents*—W. T. Evans and C. P. Senior. *Committee*—C. Hornby, J. Fortune, E. F. Taylor, E. P. Wood, J. Smith, H. J. Dean. *Treasurer*—W. J. Cresswell. *Secretary*—J. Taylor, 103 Lightbourne Road, Moston, Manchester.

Northampton Natural History and Field Club (Photographic Section).—(ESTABLISHED 1882.)—Meetings are held at 1A Sheep Street, Northampton. *President*—H. Manfield. *Secretary*—C. H. Dorman, A.R.I.B.A., 51 Abington Street, Northampton.

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North Middlesex Photographic Society.—(ESTABLISHED 1888.)—Meetings held at Hanley Hall, Sparsholt Road, near Crouch Hill Station (M.R.). *President*—R. Child Bayley, F.R.P.S. *Vice-Presidents*—J. W. Marchant, F.R.P.S., and J. G. S. Mummery. *Council*—S. Barnard, C. Beadle, D. H. W. Broad, H. W. Bennett, F.R.P.S., F. W. Cox, A. G. Lawson, J. McIntosh, H. Smith, C. R. Steele, H. Stuart, W. Taylor. *Treasurer*—F. M. Ainsley. *Secretary*—S. H. Bentley, 30 Womersley Road, Crouch End, N.

North-West London Photographic Society.—(ESTABLISHED 1901.)—Affiliated to the Royal Photographic Society. Meetings held at the North London Collegiate School, Camden Street, N.W. *President*—W. Kilbey. *Vice-President*—A. R. Toplis. *Committee*—W. Beyer, W. A. Edgar G. H. Carter, A. J. Reid, H. H. Morgan. *Delegates to the Royal Photographic Society*—Messrs. Reid and Kilbey. *Hon. Treasurer*—R. E. Winkworth. *Hon. Secretary*—H. Date, 271 Kentish Town Road, N.W. *Assistant Secretary*—C. Walker.

Nottingham Mechanics' Institution Camera Club.—(ESTABLISHED 1892.)—Meetings held at the Mechanics' Institute. *President*—His Grace the Duke of Newcastle. *Vice-Presidents*—Lord Henry Bentinck, M.P., J. H. Yoxall, M.P., Edward Bond, M.P., W. J. Abel, S. Bourne, A. Brown, F. N. Ellis, A. Pyatt, G. H. Wallis, C. B. Wright, H. Tolley. *Committee*—A. W. Flowerdew (Chairman), T. Wright, A. R. Hartley, A. Black, J. Anderson, W. R. Anderson, Rev. W. H. Kynaston, M.A. *Curator of Survey Prints*—J. T. Radford. *Albums Secretary*—Lance Allen. *Hon. Secretary and Treasurer*—W. Ward.

Oldham Photographic Society.—(ESTABLISHED 1867.)—Meetings held at the Oldham Lyceum, Union Street, Oldham. *President*—Thomas Widdop *Vice-President*—R. T. Taylor. *Council*—J. H. Brierley, T. Burton, J. W. Cooper, William Schofield, J Hall. *Librarian*—J. Fullalove. *Treasurer*—J. Whitehead. *Hon. Secretary*—S. Ashton, 91 Waterloo Street, Oldham. *Assistant Secretary*—J. Siddall, 58 Greengate Street, Oldham.

Oxford Camera Club.—(ESTABLISHED 1894.)—Meetings held at the University Museum. *President*—Sir W. J. Herschel, Bart. *Vice-Presidents*—Miss Acland, Miss Venables, Colonel Impey, Claude Rippon. *Committee*—Rev. W. M. Merry, E. A. Bevers, E. C. H. Jessop, A. Robinson, G. Shelton, Dr. Mann, H. T. Leach. *Treasurer*—R. A. R. Bennett. *Secretary*—George W. Norton, 149 Woodstock Road, Oxford.

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Peterborough Photographic Society.—(ESTABLISHED 1887.)—Meetings held at the Bedford Temperance Hotel. *President*—G. Kirkwood, M.D. *Vice-Presidents*—T. J. Walker, M.D., J.P., E. Worthington, G. W. Leigh. *Committee*—J. F. Perkins, W. H. Pentney, A. W. Nichols, W. Atkinson, T. W. Rogers. *Treasurer*—H. C. Lilley. *Secretary*—A. C. Taylor, Trinity Street, Peterborough.

Photographic Convention of the United Kingdom.—(ESTABLISHED 1886.)—The Seventeenth Annual Meeting will be held at Cambridge in July, 1902, under the Presidency of Sir Robert S. Ball. Retiring President (Oxford, 1901), Sir William J. Herschel, Bart. The Photographic Convention was founded in 1886 for the advancement of photography, and to afford opportunities for personal intercourse and exchange of ideas amongst those interested in the art. The Council of the Convention is empowered to make grants from the surplus funds under its control, in aid of photographic research. Meetings have been held at the following centres:—Derby, Glasgow, Birmingham, London, Chester, Bath, Edinburgh, Plymouth, Dublin, Shrewsbury, Leeds, Great Yarmouth, Glasgow (second visit), Gloucester, Newcastle-on-Tyne, and Oxford. *Past Presidents*—J. Traill Taylor, Andrew Pringle, C. H. Bothamley, George Davison, William Bedford, George Mason, Sir Howard Grubb, A. Haddon, H. P. Robinson, F. P. Cembrano, John Stuart, W. Crooke, Thomas Bedding. *Members of Council*—Harold Baker (London), G. B. Bainbridge (Newcastle-on-Tyne), W. Barry (Hull), Godfrey Bingley (Leeds), Alexander Cowan (London), W. J. Croall (Edinburgh), T. R. Dallmeyer (London), W. E. Dunmore (London), Alfred Ellis (London), S. H. Fry (London), F. Gandy (Derby), J. Pattison Gibson (Hexham), H. M. Hastings (London), E. J. Humphery (London), Colonel Impey (Oxford), E. C. H. Jessop (Oxford), Sydney Keith (Hounslow), C. Phipps Lucas (London), Percy Lund (Bradford), J. L. Lyell (London), Colonel Lysaght (Pretoria, S.A.), Rev. W. M. Merry (Oxford), A. F. Mowll (Liverpool), Rev. T. Perkins (Blandford), Claude Rippon (Oxford), Ralph Robinson (Redhill), J. A. C. Ruthven (Dublin), F. H. Sanderson (Cambridge), A. Seaman (Chesterfield), H. Sturmey (Coventry), Alexander Tate (Belfast), W. Taylor (Leicester), J. H. Walker (Leeds), E. J. Wall (London), H. Snowden Ward (London), S. B. Webber (London), G. Watmough Webster (Chester), J. B. B. Wellington (Elstree), A. Werner (Dublin). R. W. Dugdale (Gloucester), W. Thompson (Newcastle-on-Tyne), and G. W. Norton (Oxford), are by Rule XII. *ex-officio* members of Council for one, two, and three years respectively. Past-Presidents who remain members of the Convention are by Rule X. Vice-Presidents and *ex-officio* members of Council. *Trustees*—Samuel Blatchford Webber and Frederick Albert Bridge. *Hon. Secretary and Treasurer*—F. A. Bridge, East Lodge, Dalston Lane, London N.E.

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Photographic Society of Ireland.—(Established 1854.)—Meetings held at 35 Dawson Street, Dublin. *President*—J. A. C. Ruthven, A.M.I.C.E.I. *Vice-Presidents*—Victor E. Smyth and R. M. Inglis. *Council*—A. M. Geddis, H. Goodwillie, J. H. Woodworth, George E. Mathews, R. L. Bewley, J. H. Gane, E. Webb Smith, W. H. Brayden, H. Pollock, James Simpson. *Hon. Treasurer*—William Bewley, B.A. *Secretary*—W. F. Cooper.

Photographic Survey of Warwickshire.—(Established 1890.)—Meetings held at the Rooms of the Birminghan Photographic Society, Norwich Chambers, Birmingham. *President*—Sir J. B. Stone, M.P., F.G.S., F.L.S. *Vice-President*—J. H. Pickard. *Committee*—Oliver Baker, F. Lewis, J. A. Leeson, B. Moore, T. Taylor. *Treasurer*—G. F. Lyndon, J.P. *Secretary*—George Whitehouse, 7 Wye Cliff Road, Handsworth, Birmingham.

Plumstead (All Saints') Photographic Society.—(Established 1896.)—Meetings are held at the Mission Hall, Herbert Road. *President*—Rev. J. W. Morris, M.A. *Vice-Presidents*—Colonel N. S. S. Watkin, C.B., R.A., E. A. Hastings Jay, H. F. Donaldson, M.I.C.E. *Chairman*—H. Clutterbuck, M.I.M.E. *Committee*—Messrs. Arnold, Goldthorpe, Grant, and Stone. *Librarian and Assistant Secretary*—E. Kemp. *Secretary and Treasurer*—G. V. Taylor, 29 Vernham Road, Plumstead, S.E.

Plymouth Photographic Society.—(Established 1894.)—Meetings are held at The Athenæum, Plymouth. *President*—Charles H. Dymond. *Vice-Presidents*—F. Johnson and W. H. Mayne. *Committee*—W. H. Harris, A. W. Hicks, W. C. Johns, G. Johnson, F. H. Pearse, J. D. Turney, E. G. Turney, F. A. Wiblin. *Delegates to R.P.S.*—H. S. Hill and G. F. Treleaven. *Treasurer*—John Trouern Trend. *Secretary*—Wilfrid Grist, 105 Old Town Street, Plymouth.

Plympton Photographic Society.—(Established 1894.)—*President*—Dr. Aldridge. *Committee*—Dr. Ellery, J. Brooking Rowe, C. H. Stevens, H. Tritton. *Secretary and Treasurer*—T. H. Wilks, Plympton House, Plympton, South Devon.

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Postal Camera Club.—(ESTABLISHED 1894.)—A circulating Club for advanced workers only. The portfolios circulate with regularity. Prints are inserted and withdrawn by the members as the portfolio arrives monthly. *Hon. Secretary*—W. R. Bland, Duffield, Derby.

Postal Photographic Club.—(ESTABLISHED 1886.)—*Secretary and Treasurer*—Reginald A. R. Bennett, M.A. (Oxon.), Walton Manor Lodge, Oxford.

Prescot and District Amateur Photographic Association.—(ESTABLISHED 1896.)—Meetings held at the Rooms, Bank Buildings, Derby Street, Prescot. *Chairman*—J. Blaiklock. *Committee*—A. Tracey, F. V. Driffield, John Whitaker, E. Davies, J. S. Robinson, B. A. Giuseppi, W. A. Cross, E. Taylor. *Treasurer*—Charles T. Wills. *Hon. Secretary*—W. Langley.

Preston Scientific Society (Photographic Section).—(ESTABLISHED 1896.)—Meetings held at 119A Fishergate, Preston. *Chairman*—J. J. Shaw. *Vice-Chairman*—C. A. Swift, M.A. *Committee*—J. D. Marsden, W. Croasdale, W. Phillips, Henry P. Burton, G. Busby, W. Baron. *Secretary*—A. W. Cooper, 9 Jordan Street, Preston.

Professional Photographers' Association.—(ESTABLISHED 1901.—*President*—Thomas Bedding, F.R.P.S. *Vice-President*—H. Walter Barnett. *Committee*—Ten London Members: Harold Baker, F. A. Bridge, Ernest Elliott, H. Hallier, H. E. Hull, Martin Jacolette, Alexander Mackie, Lang Sims, J. Caswall Smith, T. C. Turner; Ten Country Members: W. Barry (Hull), T. Birtles (Warrington), William Crooke (Edinburgh), G. W. Morgan (Aberdeen), Gustave Mullins (Ryde), Henry C. Spink (Brighton), W. D. Valentine, J.P. (Dundee), H. J. Whitlock (Birmingham), G. W. Webster (Chester). *General Purposes Sub-Committee*—F. A. Bridge, Martin Jacolette, H. C. Spink (Brighton), Ernest Elliott (Elliott & Fry), Alexander Mackie. *Local Branches Organization Sub-Committee*—Harold Baker (Birmingham), T. Birtles (Warrington), Gustave Mullins (Ryde), W. D. Valentine, J.P. (Dundee), G. W. Webster (Chester), W. Barry (Hull), W. Crooke (Edinburgh), G. W. Morgan (Aberdeen), H. C. Spink (Brighton), H. J. Whitlock (Birmingham), T. C. Turner (Hon. Secretary), 8 Regent's Terrace, Hull. The President, Vice-President, Hon. Treasurer, and Hon. Secretary are *ex-officio* members of all Committees. *Hon. Solicitor*—P. E. Marshall. *Bankers*—National Provincial Bank of England. *Hon. Treasurer*—William Grove. *Hon. Secretary*—Alfred Ellis, 51 Baker Street, London, W. *Assistant Secretary*—E. W. Simmons, 51 Baker Street, London, W.

Pudsey District Photographic Society.—(ESTABLISHED 1891).—Meetings held at the Mechanics' Institute. *President*—Dr. Hunter. *Secretary and Treasurer*—R. Waring-Taylor, Boarding House, Fulneck, near Leeds.

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Redhill and District Camera Club.—(ESTABLISHED 1898.)—Meetings held in the North Room, Market Hall, Redhill. *President*—Francis H. Ellwood, L.D.S. *Vice-Presidents*—Numerous. *Committee*—A. H. Dunning (Lanternist), T. P. Padwick (Portfolio Sec.), F. Martin Duncan, A. F. Torrance (Excursion Sec.), F. Pullen Candy (Journalistic Sec.), J. A. Carter, B.A., W. J. Hatton, G. W. Peat, T. B. Yates. *Treasurer*—Dr. Blackler. *Secretary*—William Rowlinson, 80 Garlands Road, Redhill.

Richmond Camera Club.—(ESTABLISHED 1890.)—Meetings held at the Greyhound Hotel, Richmond, Surrey. *President*—F. P. Cembrano. *Vice-Presidents*—G. Ardaseer and C. H. Davis. *Committee*—J. H. Alabaster, H. Dale, C. G. Emery, J. D. Gibson, E. Oetzmann, Dr. Rodman. *Treasurer*—J. B. Huddy. *Secretary*—E. G. Richardson, 13 Dynevor Road, Richmond, Surrey.

Ripon Portfolio Club.—(ESTABLISHED 1899.)—*Hon. Secretary*—H. Bulmer Rudd, 29 Westgate, Ripon.

Rochdale and District Photographic Society.—(ESTABLISHED 1890.)—*President*—J. A. Bright. *Vice-Presidents*—Colonel C. M. Royds, M.P., Alderman J. R. Heap, Rev. T. P. Spedding. *Treasurer*—W. Bamford. *Secretary*—George W. Jones, 36 Smith Street, Rochdale.

Rodley and District Photographic Society.—(ESTABLISHED 1893.)—Meetings are held at Rodley, near Leeds. *President*—G. W. Bentley. *Vice-Presidents*—Charles Gaunt and B. O. Pearson. *Committee*—J. F. Ashby, J. W. Nicholson, John Ross. *Treasurer*—Harry Hardaker. *Secretary*—H. Crossley, Rodley, near Leeds.

Röntgen Society.—(ESTABLISHED 1897.)—Meetings are held at 20 Hanover Square. *President*—Herbert Jackson, F.C.S. *Treasurer*—J. J. Vezey, F.R.M.S. *Secretary*—F. Harrison Low, M.B., &c., 12 Sinclair Gardens, West Kensington.

Rotherham Photographic Society.—(ESTABLISHED 1889.)—Meetings held at 5 Frederick Street, Rotherham. *President*—F. B. Judge Baldwin, M.R.C.S. *Vice-Presidents*—E. Isle Hubbard, M.S.A., J. Leadbeater, W. Rider. *Council*—J. Caseldine, J. C. Cox, C. E. Davis, W. Firth, J. W. Stamp. *Treasurer*—Alfred S. Lyth. *Secretary*—H. C. Hemmingway, F.J.I., Tooker Road, Rotherham.

Royal Photographic Society.—(ESTABLISHED 1853.)—Meetings are held at 66 Russell Square, London, W.C. *President*—Thomas R. Dallmeyer, F.R.A.S. *Vice-Presidents*—The Right Hon. the Earl of Crawford, K.T., F.R.S., Chapman Jones, F.I.C., F.C.S., J. W. Swan, M.A., F.R.S., Major-General J. Waterhouse, I.S.C. *Council*—T. Bolas, F.I.C., F.C.S., C. H. Bothamley, F.I.C., F.C.S., F. A. Bridge, A. Cowan, P. H. Emerson, B.A., M.B., H. Vivian Hyde, Rev. F. C. Lambert, M.A., A. Mackie, J. W. Marchant, Prof. R. Meldola, F.R.S., E. Sanger Shepherd, J. A. Sinclair, J. Spiller, F.I.C., F.C.S., John Sterry, W. Thomas, H. Snowden Ward, J. B. B. Wellington. *Editor of the Journal*—Sir W. de W. Abney, K.C.B., F.R.S. *Hon. Solicitor*—F. Ince. *Hon. Librarian*—H. Wilmer. *Hon. Treasurer*—G. Scamell. *Hon. Secretary*—John A. Hodges. *Assistant Secretary*—A. W. W. Bartlett, 66 Russell Square, London, W.C.

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Royal Cornwall Polytechnic Society.—(ESTABLISHED 1833).—*Patron*—His Most Gracious Majesty the King. *President*—Sir William H. Preece, K.C.B., F.R.S. *Vice-Presidents*—Sir Edwin Durning-Lawrence, Bart., M.P., Sir Joseph Fayrer, Bart., M.D., F.R.S., K.C.S.I., Robert Fox, C.C., Henry S. Tuke, A.R.A., Sir Walter Trevelyan, Bart., Rev. J. S Flynn, B.D., Alfred Bache, Assoc. Inst. C.E., Thurstan C. Peter, The Lord Bishop of Truro, Prof. A. W. Rücker, D.Sc., F.R.S., Sir Richard Tangye, F. J. Bowles. *Curator*—H. S. Hill, M.S.I. *Hon. Librarian*—W. Lethaby. *Secretary*—Edward Kitto, F.R.Met.Soc , Falmouth.

Scarborough and District Photographic Society.—(ESTABLISHED 1890.)—Meetings are held in the Museum, Scarborough. *President*—A. H. Robinson. *Vice-President*—J. H. Rowntree. *Committee*—Mrs. Graham, Miss McCallum, E. R. Cross, T. C. Binnie, C. E. Wanless, G. Whitfield. T. F. Brogden. *Treasurer*—J. Whitfield. *Secretary*—Harry Wanless, 31 Westborough, Scarborough.

Shaw Church Institute Photographic and Art Society.—(ESTABLISHED 1888.)—*President*—Rev. J. T. Ormerod, M.A. *Vice-President*—J. W. Farrar. *Committee*—J. R. Royds, J. H. Broadbelt, J. R. Heaton. *Secretary*—John Maiden, 93 Rochdale Road, Shaw, near Oldham.

Sheerness Camera Club.—(ESTABLISHED 1896.)—Meetings held at the Conservative Club, The Broadway. *President*—Capt. T. E. Dexter. *Vice-President*—J. Kingwell. *Committee*—J. Small, Sergt. Jones, R.G.A., S. Norrington, A. E. Doran. *Treasurer*—Mr. Jago. *Secretary*—Frederick Cork 16-18 and 53 High Street, Sheerness-on-Sea.

Sheffield and Hallamshire Photographic Society.—(ESTABLISHED 1896.)—Meetings are held at The Sheffield Photographic Company's Rooms, 95 Norfolk Street, Sheffield. *President*—F. Mottershaw. *Vice-Presidents*—G. H. Bagshaw, R. Heathcote, J. A. Leach. *Committee*—G. Bingham, A. Bingham, L. Britton, F. Belling, J. Cunningham, J. Ellis, — Anderson, — Haykin. *Treasurer*—John W. Mottershaw. *Secretary*—Fred Lowe, 41 Carrington Road, Sheffield.

Sheffield Optical Lantern Society.—(ESTABLISHED 1890.)—Meetings held at St. Paul's Schools, Cambridge Street, third Thursday in the month. *President*—Dr. J. A. Manton. *Vice-Presidents*—J. H. Lygo, J. W. H. Wilson, Hy. Staniforth, B. Carr, J. Clowes. *Council*—J. Temperton, M. Wilson, C. Thornhill, J. E. Glenn, T. W. Simonson, J. Cunningham, S. Hughes. H. J. Claque, J. W. Copley. *Reporter*—J. Cunningham. *Treasurer*—E. Copley. *Secretary*—T. G. F. Allen, 59 Melrose Road, Sheffield.

Sheffield Photographic Society.—(ESTABLISHED 1876.)—Meetings are held at the Masonic Hall. *President*—Dr. Paterson. *Vice-Presidents*—Sparham Camp, G. H. Day, G. Tomlinson. *Council*—G. W. Charlesworth, W. T. Furniss, H. Hill, J. H. Lygo, J. Smith. *Treasurer*—T. G. Hibbert. *Secretary*—T. H. Muxlow, 136 Steade Road, Sharrow, Sheffield.

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Shropshire Camera Club.—(ESTABLISHED 1886.)—Meetings are held at the Club-room, Castle Street, Shrewsbury. *President*—W. E. Harding. *Vice-Presidents*—M. J. Harding, J. R. Greatorex, J. L. Della-Porta, Dr. Cureton. *Council*—F. R. Armytage, H. H. Hughes, P. W Pilcher, R. J. Irwin, Rev. Dr. Moriarty, H. W. Hughes. *Hon. Treasurer*—H. Atkin. *Hon. Secretary*—W. D. Haydon, The Schools, Shrewsbury.

Society for the Encouragement of Arts, Manufactures, and Commerce.—(FOUNDED IN 1754. INCORPORATED BY ROYAL CHARTER IN 1847.)—Meetings are held at John Street, Adelphi, London, W.C. *President*—Sir Frederick Bramwell, Bart., D.C.L., F.R.S. *Vice-Presidents*—H.R.H. the Duke of Cornwall and York, K.G., Duke of Abercorn, K.G., C.B., Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S., The Lord Chief Justice, G.C.M.G., Lord Avebury, D.C.L., F.R.S., Sir Benjamin Baker, K.C.M.G., F.R.S., Sir John Wolfe Barry, K.C.B., F.R.S., Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Lord Belhaven and Stenton, Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D., Sir Edward Birkbeck, Bart., Michael Carteighe, F.C.S., Sir Edwin Durning-Lawrence, Bart., M.P., Sir John Evans, K.C.B., D.C.L., LL.D., F.R.S., Hon. Sir Charles W. Fremantle, K.C.B., Henry Graham Harris, Sir Charles Malcolm Kennedy, K.C.M.G., C.B., Ludwig Mond, Ph.D., F.R.S., Hon. Richard Clere Parsons, Lord Rothschild, Sir Thomas Sutherland, G.C.M.G., M.P., Sir William Henry White, K.C.B., LL.D., F.R.S.. *Ordinary Members of Council*—Professor Francis Elgar, LL.D., F.R.S., Sir Robert Giffen, K.C.B., LL.D., F.R.S., Robert Kaye Gray, Sir William Lee-Warner, K.C.S.I., M.A., Charles Phipps Lucas, C.B., Sir Walter Peace, K.C.M.G., Sir William Henry Preece, K.C.B., F.R.S., Sir Walter S. Prideaux, Sir William Chandler Roberts-Austen, K.C.B., F.R.S., Alexander Siemens, Carmichael Thomas, John I. Thornycroft, F.R.S. *Auditors* — Knox, Cropper, & Co. *Treasurers* — Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Sir Owen Roberts, M.A., D.C.L., F.S.A. *Secretary*—Sir Henry Trueman Wood, M.A. *Assistant Secretary* — Henry B. Wheatley, F.S.A.

Southampton Camera Club.—(ESTABLISHED 1896.)—Meetings held at the Philharmonic Hall. *President*—W. Burrough Hill, F.S.I. *Vice-Presidents*—A. Horsley Hinton, G. T. Vivian, Rev. E. C. Bennett. *Committee*—W. Max Mills, H. Copeland, G. R. Johnson, J. Compton, W. Jarvis, M. O'Connor. *Treasurer*—W. H. Trigg. *Secretary*—S. G. Kimber, Oakdene, Highfield, Southampton.

South Norwood Photographic Society.—Meetings are held at the Constitutional Club, South Norwood Hill. *President*—John Smith. *Vice-Presidents*—J. T. Sandell and E. Pierce. *Council*—General Bedford, T. R. Brailsford, B. T. Luckett, G. R. Nicholls, W. E. Nicholls, T. Page, H. Scott, C. Morgan Smith. *Hon. Lanternist*—W. Warner. *Treasurer*—F. C. Bause. *Hon. Secretary*—L. W. Bause, 125 Portland Road, South Norwood. *Assistant Hon. Secretary*—G. R. Beckett.

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South London Photographic Society.—(ESTABLISHED 1888.)—Affiliated with the Royal Photographic Society. Meetings are held at Hanover Hall, Hanover Park, Rye Lane, Peckham, S.E. *Patrons*—His Grace the Duke of Newcastle and G. A. Maull. *President*—Charles H. Oakden, F.R.C.S. *Vice-Presidents*—Maurice Howell, M.P.S., S. W. Gardner, W. F. Slater, F.R.P.S., A. E. Allen, J. T. French. *Committee*—J. T. French, M. Howell, W. F. Slater, C. F. Dickinson, E. G. Ruckes, E. R. Bull, G. J. T. Walford, H. Esler, F. W. Grigg, E. Mathews, B. Lyon, A. Fellows, J. K. Ayling, C. Budd, C. W. Walker. *Curator*—W. C. Boyce. *Hon. Lanternist*—H. F. Mawbey. *Delegates to the Affiliation of Photographic Societies*—Charles H. Oakden, F.R.P.S., and Frank Goddard. *Hon. Treasurer*—C. Churchill. *Hon. Secretary*—F. Goddard, Woodlands, Vanbrugh Hill, Blackheath, S.E. *Hon. Assistant Secretary*—S. W. Whiteman, 8 Camberwell Road, S.E. *Hon. Excursion Secretary*—H. C. Beckett, 44 Edith Road, Peckham, S.E.

Southport Photographic Society.—(ESTABLISHED 1890.)—Meetings held at the Temperance Institute. *President*—D. E. Benson, A.M.I.C.E. *Vice-Presidents*—J. R. Cave, M.P.S., and S. C. Blackshaw. *Committee*—Willis Brunt, J. S. Chree, G. N. Clark, E. W. Johnson, J. Noton. *Treasurer*—Joseph Lambert. *Secretary*—George Cross, 15 Cambridge Arcade, Southport.

Southport Y.M.C.A. Camera Club.—(ESTABLISHED 1896.)—Meetings held at the Y.M.C.A. Rooms, Eastbank Street, Southport. *President*—S. J. Elliott. *Vice-Presidents*—Henry Ball and S. R. Parks. *Committee*—S. Y. Ormerod, E. W. Mellor, P. Dickinson, T. E. Harrison, W. H. G. Lea. *Treasurer*—J. T. Rigby. *Secretary*—F. B. Jesper, 8 Promenade, Southport.

Southsea Photographic Society.—(ESTABLISHED 1888.)—Meetings held at Pembroke Road, Portsmouth. *President*—Dr. C. H. Newby, F.R.C.S. *Vice-President*—W. G. Lewis. *Council*—H. T. Lilley, M.A., A. Fisher, A.S.A., George Stanford, G. Whitefield, G. Wood, A.R.I.B.A., J. H. Franckeiss. *Hon. Lanternist*—E. H. Purvis. *Treasurer*—H. A. Canning, L.D.S. *Secretary*—F. J. Mortimer, 10 Ordnance Row, Portsea, Portsmouth.

South Shields Photographic Society.—(ESTABLISHED 1894.)—Meetings held at the Y.M.C.A. Rooms, Charlotte Terrace, South Shields. *President*—J. Davenport. *Vice-Presidents*—A. E. Cowling, H. G. Fowler, W. Parry, A. J. Hunter, W. Hoare, T. E. Taber, J. Kyle, C. W. Wood. *Council*—W. E. Beck, H. Clark, R. Brady, A. Joures, G. S. Robinson, P. G. Lawson. *Treasurer*—M. H. Sadler. *Secretaries*—A. W. Hoare and R. Brady, 53 Wouldhave Street, South Shields.

Stafford Photographic Society.—(ESTABLISHED 1895.)—Meetings held at the Old Police Barracks, Austin Friars, Stafford. *President*—H. W. Cooper. *Vice-President*—F. Cliff. *Committee*—H. Cliff, T. W. Davies, W. Kirkham, J. Venables. *Treasurer*—George Wray. *Secretary*—Henry E. Burn, Totnam Villa, Stone Road, Stafford.

FOR ENLARGEMENTS
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Stereoscopic Club.—(ESTABLISHED 1890.)—Meetings held at the Star Hotel, Manchester. *Secretary*—W. I. Chadwick, Star Hotel, Manchester.

Stereoscopic Society.—(ESTABLISHED 1893.)—*President*—W. W. Stainthorpe, M.A., M.D., J.P. *Vice-Presidents*—Herr Victor Selb and F. Dunsterville. *Secretary and Treasurer*—B. Diveri, B.A., Viewfield, Huntly, N.B.

St. Michael's Photographic Club.—(ESTABLISHED 1896.)—Meetings held at the Institute, 45 St. Michael's Road, Liverpool. *President*—Rev. H. Gresford Jones, M.A. *Secretary*—R. J. Lutas, 17 Elsmere Avenue, Sefton Park, Liverpool.

Stockport Photographic Society.—(ESTABLISHED 1889.)—Meetings are held at the Mechanics' Institution. *President*—Colonel Henry Turner, J.P. *Committee*—C. H. Battersby, J. Barlow, R. Gardner, T. Lindop, J. Middleton, S. Platt, A. W. Slater. *Treasurer*—John J. Rothwell. *Secretary*—Thomas Gould, 116 Chestergate, Stockport.

Stoneycroft (Liverpool) Camera Club.—(ESTABLISHED 1895.)—Meetings are held in the People's Hall, Prescot Road, Stoneycroft. *President*—Dr. Ivor Thomas. *Vice-Presidents*—C. E. Hancox and W. S. Cook. *Council*—W. E. Inston, G. E. Gidman, F. Walmsley, T. R. Olver. *Hon. Lanternist*—Herbert Johnson. *Hon. Secretary and Treasurer*—M. Short, 4 Harriet Terrace, Queen's Road, Liverpool.

Sun & Company.—(ESTABLISHED 1886.)—A Postal Photographic Society for advanced workers, limited to forty amateurs, for the monthly circulation and criticism of photographs, entirely the work of members, and for a general interchange of ideas, with a view to mutual advancement in the science and art of photography. *Committee*—H. Newson, Colonel Biggs, Wallace Heath, and the Hon. Secretary. Application for vacancies should be made to the Hon. Secretary, Martin J. Harding, Egerton House, Havelock Road, Shrewsbury.

Sunbeam Postal Photographic Society.—(ESTABLISHED 1890.)—An ever-circulating portfolio to members monthly for criticisms, discussions, and occasional competitions. *Secretary and Treasurer*—R. W. Copeman, Henstridge, Blandford, Dorset.

Sunderland Camera Club.—(ESTABLISHED 1899.)—Meetings held fortnightly in the Ennerdale Lecture Hall. *Chairman*—W. Percy Mail. *Vice-Chairman*—K. S. Yeaman. *Committee*—F. W. C. Common, W. P. Mail, S. Ord, H. W. Wardropper, K. S. Yeaman, H. C. Coatsworth. *Librarian*—O. Moller. *Auditor*—F. W. C. Common. *Hon. Secretary and Treasurer*—H. Wallis Wardropper, Belle Vue Park, Sunderland. *Hon. Assistant Secretary*—Selby Ord.

Sunderland Photographic Association.—(ESTABLISHED 1888.)—Meetings held at the Subscription Library. *President*—William Milburn. *Vice-Presidents*—William Bartram and William Horan. *Council*—G. Bartram, R. G. Posgate, T. Fitzgibbon Forde, W. C. Brown, A. Peddie, J. Deans, C. Cothay, J. Pratt. *Auditor*—William Carter. *Hon. Treasurer*—W. Pope. *Hon. Secretary*—William E. Kieffer, 1 Sterling Street, Sunderland.

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Sutton Photographic Club.—(ESTABLISHED 1896.)—Meetings held at Public Hall Chambers, Sutton, Surrey. *President*—E. De Clifford, B.A. *Vice-President*—J. A. Formoy, F.R.A.S. *Committee*—C. J. Marshall, H. C. Marshall, W. Hooper, A. D. Collins. *Secretary and Treasurer*—A. P. Hoole, The Willows, Sutton, Surrey.

Talbot Album Club.—(ESTABLISHED 1886.)—*Secretary*—Frederick H. Davies, Hampton-in-Arden, Warwickshire.

Tewkesbury Photographic Society.—*President*—Rev. G. Beebee. *Committee*—Messrs. Ridler, Bannister, and Stroud. *Hon. Treasurer*—Mr. Gardner. *Hon. Secretary (pro tem)*—J. J. Price.

'The Argosy' Postal Photographic Club.—(ESTABLISHED 1887.)—*Secretary*—Rev. C. F. Lowry Barnwell, Stramshall Vicarage, Uttoxeter.

The Guild, Leeds.—(ESTABLISHED 1900.)—*Hon. Secretary and Treasurer*—R. Stockdale, 17 Mount Preston, Leeds.

Thornton Heath Polytechnic Photographic Society.—(ESTABLISHED 1899.) Meetings are held at the Thornton Heath Polytechnic. *President*—C. Owen Fowler, M.D. *Vice-Presidents*—Alderman G. J. Allen, J.P., F. O. Bynoe, R. Child Bayley, F.R.P.S., A. B. Chatwood, B.Sc., G. Edwards. *Committee*—Mrs. F. O. Bynoe, W. C. H. Anson, G. F. Course, B. E. Edwards, W. G. Langridge, A. Goymer, P. Putnam, J. H. Robertson, W. H. Rogers. *Hon. Lanternist*—W. H. Rogers. *Hon. Librarian*—P. Putnam. *Hon. Treasurer*—T. Ironmonger. *Hon. Secretary*—W. Burwell Smith, 34 Ecclesbourne Road, Thornton Heath.

Trinity College (Glenalmond) Photographic Society.—(ESTABLISHED 1886.)—*President*—A. S. Reid, M.A., F.R.S. *Vice-President*—E. S. Lytell. *Committee*—Photographic Committee. *Treasurer*—G. S. Kennedy. *Secretary*—K. Barge, Trinity College, Glenalmond, Perth, N.B.

Tunbridge Wells Amateur Photographic Association.—(ESTABLISHED 1887.)—Meetings held at the Club Room, Mechanics' Institute, Dudley Road. *Patron*—Sir David Salomons, Bart., J.P., D.L. *President*—Frances G. Smart, M.A. *Vice-Presidents*—E. R. Ashton, Rev. A. T. Scott, M.A., R.D., J. Sidney Snelgrove. *Committee*—J. H. Chapman, A. W. Pierson, J. H. Spencer, H. Wild. *Hon. Lanternist*—A. W. Pierson. *Hon. Auditor*—Edward Catchpole. *Treasurer*—B. Whitrow. *Secretary*—Joseph Chamberlain, Tankerville, Cambridge Street, Tunbridge Wells.

Tyne Side Camera Club.—*President*—A. B. Gardiner.—*Hon. Secretary*—J. F. McKie, 9 Rye Hill Cottages, Newcastle-upon-Tyne.

Ulster Amateur Photographic Society.—(ESTABLISHED 1885.)—Meetings held at the Museum, College Square, N. Belfast. *President*—William Gray, M.R.I.A. *Vice-Presidents*—J. J. Andrews, L.D.S., John Brown, Professor Letts, Ph.D., F.R.S.E., F.S.E., Cecil E. Shaw, M.A., M.D., James Stelfox, C.E., Alexander Tate, C.E., W. S. Williames. *Committee*—Miss E. Haslett, Miss W. Haslett, William McLean, E. Mitford Martin, D. Elliott, B.A., Thomas Hamilton, Edward Bingham, General Bland, R.E., James M'Cleery. *Hon. Librarian*—D. Elliott, B.A. *Hon. Treasurer*—J. Campbell Carson. *Hon. Secretary*—Thomas Nolan Murray, The Museum, College Square N., Belfast.

FOR BROMIDE PAPERS
INVENTORS·AND·STILL·FIRST

Uttoxeter Photographic Society.—(Established 1890.)—Meetings are held at Carter Street, Uttoxeter. *President*—Rev. C. F. L. Barnwell. *Vice-Presidents*—F. A. Bolton and C. W. Lyon. *Committee*—S. B. Bamford, J.P., H. Holmes, Alfred Parker, R. Walker, E. Edwards, R. T. Hardy. *Treasurer*—R. T. Hardy. *Secretary*—Rev. C. F. L. Barnwell, Stramshall Vicarage, Uttoxeter.

Wakefield Photographic Society.—(Established 1890.)—Meetings are held at the Church Institution. *President*—Charles Miles. *Vice-Presidents*—H. M. Briggs, W. Holmes, A. W. Stanfield, J.P. *Committee*—J. A. Cass, A. Darbey, J. Kitson, Major Norwood, F. Tattersall, W. Woodhead. *Treasurer*—F. Judge. *Secretary*—R. Robson, 1 Dunelm Terrace, Sandal, Wakefield.

Walsall Amateur Photographic Society.—(Established 1878.)—Meetings are held at the Y.M.C.A., Freer Street, Walsall. *President*—John Hildick. *Committee*—W. H. Bullock, W. Bullock, jun., W. J. S. Brown, H. E. Butler, W. C. Checkley, F. B. Edwards, W. A. Hubball, W. Meikle, T. Partridge, H. B. Smith, George Warner, J. Whitworth. *Treasurer*—E. A. Day. *Secretary*—W. T. Comer, D.B.O.A., F.S.M.C., Arcade Walsall.

Walthamstow Photographic Society. — (Established 1894.) — *President*—W. A. Longmore. *Treasurer*—Eben. Clarke. *Secretary*—Walter H. Judson, 13 Whitney Road, Leyton.

Walton (Liverpool) Photographic Society.—(Established 1889.)—Meetings held at the Walton Church Schools, Liverpool. *President* — George Latimer. *Council*—John Kennedy, H. Sharrock, F. O. Creswell, H. Whittle, J. Parke, W. W. Maver. *Secretary and Treasurer*—T. Bickerstaff, 79 Rawcliffe Road, Walton, Liverpool.

Warrington Photographic Society.—(Established 1887.)—Meetings held at Druids' Hall, Sankey Street, Warrington. *President*—H. Bond. *Vice-Presidents*—J. Fairhurst, H. N. Houghton, J. Harding. *Council*—Messrs. Cavanagh, Armstrong, Landon, Holt, Gandy, Twiss, Winstanley, and Wilkinson, together with the Officers. *Secretary*—F. W. Knowles, 77 Bridge Street, Warrington.

Waterloo and Blundellsands Photographic Society.—(Established 1893.) —*President*—William G. Eyre. *Vice-Presidents*—J. T. Norman-Thomas, F.L.S., G. E. H. Rawlins, H. Banister. *Council*—H. Banister, W. D. Henderson, H. Bain, J. Goodyear, G. E. H. Rawlins. *Treasurer*—T. B. Dean. *Secretary*—H. J. Woodley, South View, Waterloo.

West Bromwich Municipal Science School Photographic Society.—Established 1898.)—Meetings held at the Institute, West Bromwich. *President*—R. Lloyd Whiteley, F.I.C., F.C.S. *Vice-President*—H. R. Prescott. *Committee*—F. W. Cotterell, T. W. Eayres, F. V. Wilkinson, D. G. Mackintosh. *Secretary and Treasurer*—R. Leach, 47 Birmingham Road, West Bromwich.

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West London Photographic Society.—(ESTABLISHED 1888.)—Meetings held at the Broadway Lecture Hall, Hammersmith. *President*—W. J. Bull, M.P. *Vice-President*—E. T. Holding. *Council*—H. L. Batting, A. E. Beard, W. A. Brown, W. Collett, A. Ebbs, E. E. Gibbs, F. C. Hart, H. Selby. *Hon. Lanternist*—R. Horton. *Hon. Librarian*—W. Taylor. *Hon. Treasurer*—A. E. Cockerell. *Hon. Secretary*—J. Brown, 28 Weltje Road, Hammersmith, W.

West Surrey Photographic Society.—(ESTABLISHED 1887.)—Meetings held at the Railway Hotel, 110 Battersea Rise, Clapham Junction, S.W. *President*—J. T. Price. *Vice-Presidents*—J. Bulbeck and R. Baskett. *Committee*—R. Archer, W. T. Marriott, S. Smith, C. Sheed, F. G. Tryhorn. *Librarian*—V. Serin. *Secretary and Treasurer*—W. H. Wilshere, 236 Lavender Hill, Clapham Junction, S.W.

Weymouth Photographic Society.—(ESTABLISHED 1894.)—Meetings held at the Technical Schools, Weymouth. *President*—Herbert J. Groves. *Vice-Presidents*—J. G. Rowe, W. M. Callander, T. S. Wallis. *Committee*—The President, Vice-Presidents, Treasurer, Secretary, and ten members. *Treasurer*—D. F. Allen. *Secretary*—F. C. Mace, 105 St. Mary Street, Weymouth.

Whitby Camera Club.—(ESTABLISHED 1898.)—Meetings held at the Cliff Street Board Schools. *President*—J. Bruce. *Vice-Presidents*—William Brown, E. Hall, T. Newbitt. *Committee*—William Ruff, H. S. Horne, J. T. Ross, A. G. Gray, J. Brooks, William Brown. *Secretary and Treasurer*—G. S. French, 1 West Terrace, Whitby.

Whitstable Photographic Society.—(ESTABLISHED 1900.)—Meetings held at the Foresters' Hall. *President*—T. E. Adams. *Vice-President*—F. Thurstan. *Secretary and Treasurer*—R. T. Wheeler, L.R.C.P., Ansdell House, Whitstable-on-Sea.

idnes Photographic Society.—(ESTABLISHED 1893.)—Meetings are held at Bedford Chambers, Victoria Road, Widnes. *President*—J. Newburn. *Vice-Presidents*—A. J. Squires and V. C. Driffield. *Council*—J. Appleton, F. Brown, R. J. Gow, H. T. Mannington, J. Pilling. *Treasurer*—T. Cosier. *Secretaries*—J. W. Towers, Croft Street, Widnes, and A. Hewitt, 33 Widnes Road, Widnes.

Wigan Camera Club.—Meetings are held at Hope Hall, Woodcock Street. *President*—Walter Booth. *Vice-Presidents*—William Merchant and T. Fairhurst. *Committee*—T. L. Brown, F. Fidler, W. Baron, R. Dawson, M. Brown, A. Benson, W. Simm, M. Walters. *Lanternists*—T. Winstanley and H. Cookson. *Financial Secretary and Recorder*—G. Rigby, 103 Dicconson Street, Wigan.

Wolverhampton Photographic Society.—(ESTABLISHED 1900.)—Meetings held at the Y.M.C.A. Rooms, Darlington Street. *President*—Harold Holcroft, M.A., F.C.S. *Council*—A. Whitlock, F. H. Cox, A. E. Cook, A. E. Painter, J. Morgan, D. S. Murray, J. G. Wright. *Treasurer*—Walter R. Greaves. *Secretaries*—James Gale, Finchfield Hill, Wolverhampton; H. M. Painter, 98 Waterloo Road North, Wolverhampton.

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Woodford Photographic Society.—(Established 1893.)—Meetings are held at the Wilfrid Lawson Temperance Hotel, Woodford Green. *Vice-Presidents*—H. Wilmer, F.R.P.S., and W. L. F. Wastell. *Council*—H. T. Malby, F.R.P.S., J. T. Ashby, J. E. Croom, E. H. Carpenter. *Affiliation Delegates*—E. Marriage, F.R.P.S., and J. P. W. Goodwin. *Secretary and Treasurer*—F. G. Emler, 1 Florence Villas, Chelmsford Road, Woodford, N.E.

Woolwich Photographic Society.—(Established 1892.)—Meetings held at St. John's Schools, Wellington Street, Woolwich. *President*—Charles Churchill, F.R.P.S. *Vice-Presidents*—W. H. Dawson, J. Desforges, F. W. Machen, J. B. Panting, F.R.P.S. *Council*—Douglas English, S. Hughesdon, A. E. Harris, W. Slater, F.R.P.S., G. Tapp, A. J. Wing. *Secretary and Treasurer*—W. H. Nichols, 30 Heavitree Road, Plumstead Common.

Worcestershire Photographic Survey Society. — (Established 1896.) — Meetings held at the Victoria Institute, Worcester. *President*—J. Willis Bund, D.L., F.S.A. *Vice-Presidents*—Earl Beauchamp, Lord Cobham, J. Corbett, Lord Hampton, T. J. Hobson, Sir Richard Temple, Bart. *Treasurer*—Mrs. Rowland Berkeley. *Secretaries*—Survey : Charles R. Sayer, Finstall Mount, Bromsgrove ; General : F. Littledale.

Worcester Tricycle Club (Camera Section).—(Established 1892.)—Meetings are held at 15 Albany Terrace, Worcester. *President*—J. Wilks. *Vice-President*—J. H. White. *Council*—J. Cam, F. Hill, S. Hill, T. James, J. F. Santonna. *Treasurer*—F. E. Hill. *Secretary*—T. J. Hobson, 15 Albany Terrace, Britannia Square, Worcester.

Wycombe Camera Club.—(Established 1892.)—Meetings held at the South Bucks Auction Mart, Wycombe. *President*—W. Howland. *Committee*—Messrs. Broughton, Turner, Norton, Sherriff, Burton, Fox. *Secretary and Treasurer*—J. Wilford, 7 High Street, High Wycombe.

Yeadon Photographic Society.—(Established 1896.)—Meetings held at the Lecture Hall, Yeadon. *President*—George Proctor. *Vice-Presidents*—R. P. Jibson, Dr. Muschamp, E. Lamb. *Committee*—Mrs. F. T. Coupland, E. E. Slater, Thomas Pratt, A. Myers, S. Raistrick. *Secretary and Treasurer*—E. Langley, Henshaw, Yeadon, Leeds.

York Photographic Society.—(Established 1888.)—Meetings are held at the Victoria Hall, York. *President*—W. Weatherill. *Vice-President*—A. Hardcastle. *Council*—Messrs. Brown, Dickinson, Hirst, Vincent, Saville, and Dent. *Treasurer*—R. Bainbridge. *Secretary*—Frederic G. P. Benson, 50 Scott Street, York.

Yorkshire Philosophical Society (Photographic Section).—(Established 1888.)—*President*—Tempest Anderson, M.D., J.P. *Vice-President*—J. N. Kitching. *Hon. Secretary and Treasurer*—H. Dennis Taylor, Stancliff, The Mount, York.

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COLONIAL PHOTOGRAPHIC SOCIETIES.

Amateur Photographic Association of Victoria, Melbourne.—(Establishe 1883.)—Meets monthly on the second Tuesday in each month, Informal Meetings on the fourth Monday in the month, at the Royal Society's Hall, Victoria Street, Melbourne. *President*—Dr. Kaufmann. *Hon. Secretary*—J. H. Harvey.

Auckland Camera Club.—(Established 1885.)—Meetings are held at Grey Street. *Patron*—Dr. J. Logan Campbell. *President*—R. B. Walrond. *Vice-Presidents*—J. R. Hanna, Joshua Martin, E. W. Payton, D. Goldie. *Committee*—A. G. Whittington, T. D. Leedham, S. Frith, M. Trenwith. *Secretary and Treasurer*—H. R. Arthur, c/o Auckland Gas Company.

Ballarat Photographic Club, Ballarat, Victoria.—(Established 1880.)—Meetings are held in the School of Mines, Ballarat. *President*—Professor A. Mica Smith. *Vice-Presidents*—R. J. Miller and E. Shew. *Committee*—Professor E. J. Dawbarn, R. Radcliffe, W. H. Wooster, Misses E. Purkiston, E. Baker, E. Stitfold. *Treasurer*—Mr. Hamburger. *Secretary*—Frederick J. Martell, School of Mines, Ballarat.

Barossa Camera Club, Nuriootpa, South Australia.—*Hon. Secretary*—Walter J. Ponder.

Bendigo Amateur Photographic Association.—*President*—J. B. Edwards. *Vice-President*—R. E. Jeffery. *Committee*—J. Miller, T. Hall, W. Vale, Miss Barlow, Miss Williamson. *Hon. Secretary and Treasurer*—F. D. Jones.

Canterbury Philosophical Institute (Photographic Section), Christchurch, New Zealand.—Meetings held on second Tuesday in each month. *Hon. Secretaries*—S. Page and R. C. Bishop.

Cape Town Photographic Club.—(Established 1890.)—Meetings are held at the Y.M.C.A., Cape Town. *Hon. President*—Dr. Gill, C.B., F.R.S. *Vice-President*—Dr. Muir. *Committee*—T. H. Watson, A. Gracie, G. Ainslie, J. Denham, E. J. Steer, A. McLeod, A. J. Fuller, J. P. Edwards. *Hon. Secretary and Treasurer*—H. Bishop

Central Queensland Amateur Photographic Club, Rockhampton.—*Hon. Secretary*—H. V. Sankey.

Dunedin Photographic Society.—(Established 1890.)—Meetings held at Liverpool Street, Dunedin. *President*—R. A. Ewing. *Vice-Presidents*—A. J. Barth and R. Chisholm. *Committee*—J. C. Thomson, Dr. Roberts W. Melville, C. O. McKellar, T. P. Webber. *Secretary and Treasurer*—J. Skottowe Webb, c/o National Insurance Company of New Zealand Dunedin.

FOR BROMIDE PAPERS
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Foochow Camera Club.—(ESTABLISHED 1892.)—Meetings held at the Club Rooms. *President*—G. Siemssen. *Vice-President*—F. J. Rentzsch. *Hon. Treasurer*—H. W. Churchill. *Hon. Secretary*—J. Mencarini Foochow, China.

Gordon College Amateur Photographic Association.—(ESTABLISHED 1889.)—Meetings held at Gordon College, Geelong, Victoria. *President*—H. G. Roebuck. *Vice-Presidents*—D. H. Lord and R. Mockridge. *Committee*—Messrs. Thacker, McPhillimy, Price, Leitch, and Brinsmead. *Treasurer*—S. R. J. Mawson. *Secretary*—J. Hammerton, jun., Burngreave, 73 Little Ryrie Street, Geelong, Victoria.

Hamilton Association Camera Club.—(ESTABLISHED 1892.)—Meetings held at Hamilton Association Rooms, Public Library. *President*—J. M. Eastwood. *Vice-Presidents*—A. H. Baker and W. White. *Treasurer*—George Lees. *Secretary*—W. Henry Edwards, 168 Main Street, East, Hamilton, Ontario, Canada.

Hawke's Bay Camera Club.—(ESTABLISHED 1895.)—Meetings are held at the Club Rooms, Regent Street, Napier, N.Z. *President*—Dr. J. H. E. Jarvis. *Vice-President*—F. W. Williams. *Committee*—T. B. Bear, S. E. Cooper, R. J. Duncan, A. A. Kennedy, F. J. Shanly, A. J. Williams. *Secretary and Treasurer*—W. Beswick, Post Office, Napier.

Ipswich and West Moreton Amateur Photographic Society, Ipswich Queensland—(ESTABLISHED 1893.)—Meetings on the second Wednesday of each month. *Hon. Secretary*—E. Bostock, Brisbane Street, Ipswich, Queensland, Australia.

Johannesburg Photographic Society.—Headquarters and Dark Rooms, Reliance Buildings, Kerk Street. Ordinary meetings, first and third Thursdays, commencing at eight p.m. *President*—J. Percy Fitzpatrick. *Vice-Presidents*—Dr. Kendal Franks and Rev. J. C. Harris. *Committee*—Dr. H. W. Bloomfield, H. Davies, W. Newby-Fraser, T. E. Goodall, Percy Greathead, H. R. Brownlie, J. Johnson Hoyle, J. Kuhlmann, J. H. L. Manisty, J. M. F. de Wit. *Hon. Secretary and Treasurer*—H. C. Haddon, 76 Market Street, Johannesburg.

Kimberley Camera Club.—(ESTABLISHED 1890.)—Meetings held at the Club Rooms. *President*—James Lawrence, M.L.A. *Chairman*—Montague Thane. *Vice-Chairman*—F. H. Hancox. *Council*—J. Childs, E. Goffe, L. Atkinson. *Secretary and Treasurer*—Charles Howie, P.O. Box 233, Kimberley, S.A.

Maritzburg Camera Club.—Meetings held at Club Rooms, 4 Hardy's Chambers, Printing Office Street. *President*—S. S. Watkinson. *Vice-President*—T. C. Mitchell. *Committee*—The President, Vice-President, Treasurer, Secretary, and B. Nowell Musgrove, J. Fergusson, D. M. Eadie. *Judge*—John A. Hodges, London (Hon. Secretary to the Royal Photographic Society). *Treasurer*—A. M. Hudson. *Secretary*—O. R. Swete

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Montreal Camera Club.—(ORGANIZED 1890. INCORPORATED 1892.)—Place of Meeting, 4 Phillips Square, Montreal, Canada. *President*—George Sumner. *Vice-President*—A. W. Cole. *Committee*—Edward Barry, David R. Brown, G. W. Davis, Robert W. Elliott, N. N. Evans, F. T. Jennings, James J. Mason, Archibald McLean, C. K. Temple, R. Wilson, jun. *Secretary and Treasurer*—A. Clarence Lyman, 157 St. James Street, Montreal, Canada.

Nelson Camera Club.—(ESTABLISHED 1888.)—Meetings are held at the Club Rooms, Nelson, N.Z. *President*—C. Y. Fell. *Committee*—H. Brusewitz, H. V. Gully, A. Sclanders. *Treasurer*—F. W. Hamilton. *Secretary*—A. H. Patterson, Nelson, N.Z.

Northern Tasmanian Camera Club.—(ESTABLISHED 1889.)—Meetings held at the Albert Hall, Launceston, Tasmania. *President*—F. C. Birchall. *Vice-Presidents*—William Gibson, W. H. Twelvetrees, J. Sparrow. *Committee*—H. B. Brownrigg, C. Hart, A. H. Masters. *Secretary and Treasurer*—F. Styant Browne, 112 Brisbane Street, Launceston, Tasmania.

N.S.W. Lands Department Photographic Society, Sydney.—Meetings held on the last Thursday in each month. *Chairman*—J. R. Yorke. *Committee*—O. W. Ballhausen, E. T. Davis, M. V. Murphy, H. P. Rich, R. W. Vale. *Hon. Secretary and Treasurer*—William Hamilton, Lands Department, Sydney.

N.S.W. Railway and Tramway Camera Club.—(ESTABLISHED 1894.)—Meetings held at the Railway Institute, Sydney, N.S.W. *President*—H. McLachlan. *Vice-President*—H. Carruthers. *Committee*—T. Marsh, D. C. Williamson, A. J. Leslie, C. S. Robins. *Treasurer*—J. Paterson. *Secretary*—J. Scoular, Railway Institute, Sydney, N.S.W.

Perak Amateur Photographic Society.—(ESTABLISHED 1895.)—Meetings are held in Poverty Flat, Museum Road, Taiping. *President*—L. Wray, jun., M.I.E.E., F.Z.S. *Committee*—M. J. Wright, M.B., C.M., R. O. N. Anderson, A.M.I.C.E., F. Duberly, W. van Dart. *Hon. Secretary and Treasurer*—George Bain, Taiping, Perak.

Photographic Association of Japan.—(ESTABLISHED 1893.)—Meetings held at Tokio. *President*—H.E. Prince M. Nijō. *Vice-President*—H.E. Viscount M. Nagaoka. *Committee*—H.E. Count U. Toda, H.E Viscount Enomoto, H.E, Baron Hanabusa, Captain S. Toya, Dr. T. Katō, M. Nakajima, R. Konishi, H. Shigyo, H.E. Count S. Omura, H.E. Viscount Okabe, Rigakuhakushi D. Kikuchi, K. Ogawa, I. Tanaka, Dr. Marumo, S. Kiga, S. Kajima. *Art Commissioners*—M. Nakajima, K. Ogura, K. Takahashi, R. Maruki, T. Saitō, R. Mitsumura, M. Ohashi, I. Tanaka, T. Narita, A. Futami, S. Kiga, R. Yūki. *Treasurers*—S. Ohashi and K. Ikeda. *Secretaries*—Kenji Ogura and Professor I. Ishikawa, 77 Minamienokimachi, Ushigome, Tokyo.

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Photographic Association of Canada.—(ESTABLISHED 1883.)—Place of Meeting, London, Ontario, Canada. *President*—H. S. Park (Toronto). *Vice-Presidents*—J. F. Jackson (Barrie) and W. Still (Orangeville) *Executive Committee*—H. S. Park, J. F. Jackson, W. Still, J. H. Ramsay, T. D. Hastings. *Treasurer*—J. H. Ramsay (Toronto). *Secretary*—Thomas D. Hastings, 169 Dundee Street, London, Ontario, Canada.

Photographic Society of India.—(ESTABLISHED 1886.)—Meetings are held at 57 Park Street, Calcutta. *President*—N. Giannacopulo. *Vice-Presidents*—A. Casperz and A. Tocher. *Committee*—E. S. Atherton, Oldbury Burne, J. E. Clarke, A. F. Norman, Dr. Pearse, H. J. Simmons, Maharaja Kumar, P. K. Tagore, A. Thompson, E. Thornton. *Treasurer*—C. H. Coates. *Secretary*—A. R. Catto, 57 Park Street, Calcutta.

Photographic Society of New South Wales.—(ESTABLISHED 1894.)—Meetings held at the School of Arts, Pitt Street, Sydney. *President*—His Honour Judge Docker. *Vice-Presidents*—Sir J. P. Abbott, K.C.M.G., R. W. Kirk, E. T. Davis. *Committee*—H. T. Blake, James Heron, M. V. Murphy, A. J. Perier, L. Roever. *Treasurer*—John M. Jago. *Secretary*—James S. Stening, Box 829, G.P.O., Sydney, New South Wales.

Photographic Union of New South Wales, Sydney.—Meetings held on the first Thursday of each month. *Hon. Secretary*—Charles H. Kerry.

Queensland Amateur Photographic Society.—(ESTABLISHED 1883.)—Meetings held at the Technical College, Brisbane. *President*—Dr. Wilton Love. *Vice-Presidents*—Dr. Wheeler, C. J. Pound, H. W. Mobsby. *Committee*—E. A. Blackboro', A. W. Pigott, Alexander Clark, A. G. Jackson. *Treasurer*—J. L. Kinloch. *Secretary*—W. C. Voller, 88A Queen Street, Brisbane.

Singapore Amateur Photographic Society.—Meetings are held at 53 Hill Street, Singapore. *President*—E. J. Nanson. *Committee*—A. W. Bean and G. Brinkworth. *Treasurer*—F. M. Elliot. *Secretary*—E. F. Gros, Singapore.

South Australian Photographic Society.—(ESTABLISHED 1885.)—Meetings held at the Chamber of the Society of Arts. *Patron*—His Excellency the Governor. *President*—A. H. Kingsborough. *Vice-Presidents*—F. A. Joyner and S. Smeaton. *Committee*—The Executive Officers, and C. F. Clough, A. W. Dobbie, J. Gazard, H. P. Gill. *Hon. Auditors*—W. A. West and H. H. Wight. *Hon. Treasurer*—J. D. Dixon. *Secretary*—P. H. Evans, care of the South Australian Chamber of Commerce, Adelaide, S.A. *Hon. Librarian and Assistant Secretary*—R. B. Adamson.

Southland Camera Club, Invercargil, New Zealand.—Meetings held on the third Monday in each month. *Hon. Secretary*—A. M. Macdonald Esk Stores.

St. John Camera Club.—(ESTABLISHED 1893.)—Meetings held at 65 William Street, St. John, New Brunswick. *Secretary*—J. Kaye-Allison, P.O. Box 401, St. John, N.B. Canada.

Toronto Camera Club.—(ESTABLISHED 1887.)—Meetings held at the Forum Building, Yonge Street, Toronto, Ontario. *President*—Edmund E. King, M.D. *Vice-Presidents*—J. G. Ramsey and E. Stanger. *Committee*—W. H. Moss, G. R. Baker, W. Bohne, H. B. Lefroy, W. McTaggart, H. Hampshire. *Secretary and Treasurer*—John J. Woolnough, 32 Cottingham Street, Toronto.

Upper Canada College Camera Club.—(ESTABLISHED 1891.)—Meetings are held at Upper Canada College, Toronto, Ontario, Canada. *Secretary*—O. M. Biggar, 249 Simcoe Street, Toronto, Ontario, Canada.

Wanganui Camera Club, New Zealand.—(ESTABLISHED 1894.)—Meetings are held monthly in Mr. Denton's Studio. *President*—S. Griffiths. *Vice-President*—F. Denton. *Committee*—Messrs. Allison, Kersley, Gower, Elliott, and the Officers. *Hon. Secretary and Treasurer*—C. W. Babbage, Wanganui, New Zealand.

Wellington Camera Club.—(ESTABLISHED 1892.)—Meets second Thursday in each month at Exchange Buildings, Wellington, New Zealand. *President*—A de Bathe Brandon. *Vice-Presidents*—A. C. Gifford, M.A., and J. McLellan. *Committee*—Thomas Pringle, G. W. Barltrop, M. C. Smith, W. McGregor Wright, A. B. Keyworth, M. Buckley Joyce. *Treasurer*—T. M. Hardy. *Secretary*—Joseph Alfred Heginbotham, Tea Gardens, Kilbirnie, Wellington, New Zealand.

West Australian Photographic Society, Perth.—(ESTABLISHED 1894.)—Meetings held on the third Wednesday in each month. Annual meeting in September. *Hon. Secretary*—A. R. L. Wright, Public Works Department, Perth.

Westland Camera Club, Hokitika, New Zealand.—*President*—James Park. *Hon. Secretary*—James King.

Working Men's College Photographic Club.—(ESTABLISHED 1892.)—Meetings held at the Working Men's College, Melbourne, Victoria. *President*—Prof. Kernot, M.A., M.E. *Vice-Presidents*—F. A. Campbell, C.E., T. C. Camm, A. J. Campbell. *Committee*—H. P. Bennett, T. J. Eastham, J. Alexander, H. Vanheems, W. Saunders. *Librarian*—J. Glover. *Lanternists*—A. B. Sturtevant, J. Glover, J. Cathie. *Hon. Instructor*—L. Hart, F.R.M.S. *Press Correspondent*—P. H. McElroy. *Hon. Treasurer*—E. C. Moore. *Hon. Secretary*—Arthur J. Relph, Government Printing Office, Melbourne. *Assistant Secretary*—C. R. Du Rieu.

CONTINENTAL PHOTOGRAPHIC SOCIETIES.

Amateur Fotografen Vereeniging te Amsterdam.—Established September 1, 1887. Place of Meeting, Spui (hoch), Handboogstraat 2 Ign. Bispinck, President. A. W. de Flines, Treasurer. J. P. Goedkoop, Plantago Muidergracht, 37, Secretary.

Amateur Photographen Vereeniging 'Daguerre.'—Established 1890.—Meetings held at Groningen. G. P. Smith, President. R. Roelfsema, Pzn., Vice-President. J. H. J. Gorter, Treasurer. N. de Jager, Hint. Jansstraat, Groningen, Secretary.

Association Belge de Photographie.—Established 1874. Meetings are held at the Palais du Midi, Brussels. Massange de Louvrex, President. MM. Maes et Puttemans, Vice-Presidents. A. Canfyn, A. Degryse, Dr. Gilbert, A. Goderus, J. Hermans, —Jossart, —Nieuwland, J. Casier, E. Jottrand, V. Hassreidter, H. Peltzer, L. Roland, A. Rutot, V. Selb, A. Robert, Committee. A. Nyst, Treasurer. M. Vanderkindere, 97 Avenue Brugmann, Bruxelles, Secretary.

Association Nationale des Photographes Amateurs.—Fondée le 15 Mars, 1894, et autorisée par arrêté préfectoral du 22 Décembre, 1894. Place of Meeting, au domicile du Président, actuellement à Châteaugiron (Ille-et-Vilaine). Alfred Savary, President. M. Jousseaume, Vice-President. MM. Cosnard, Le Sage de la Haye, Marnelle, and Le Millier, Committee. Roul de la Hellière, au Château de Châteaugiron (Ille-et-Vilaine), Secretary and Treasurer.

Dansk Fotografisk Forening.—Established April 5, 1879. Place of Meeting, Haandveerkerforeningen, Kronprinsensgade 7. Kjòbenhavn. Carl Sonne, President. U. C. Bauer, Vice-President. Max Schon, Committee. O. Gjòrup, Treasurer. J. Lanerberg, Kongens Nytorv 13, Kjòbenhavn, K., Secretary.

Deutsche Gesellschaft von Freunden der Photographie in Berlin.—Meldungen zum Beitritt für die Deutsche Gesellschaft von Freunden der Photographie nehmen die Mitglieder des Vorstandes entgegen und versenden dieselben auf Wunsch die 'Satzungen' der Gesellschaft. Näheres durch den Schriftführen Herrn Direktor Schultz-Hencke, Lette-Institut, Berlin S.W., Königgrätzer-strasse 90. Der Jahresbeitrag beträgt M.20,00. für Auswärtige jährlich M.14.

Deutscher Photographen Verein.—Established December 29, 1876. Place of Meeting, Düsseldorf. K. Schwier, President. Ernst Sonntag, F. Dyck, C. Kesselhulk, J. Gaediske, H. Rosenthal, Committee. K. Schwier, Weimar, Secretary and Treasurer.

Dresdner Gesellschaft zur Förderung der Amateur-Photographie, Dresden.—Established 1897. Meetings held at the Vereinshaus, 17 Zinzendorfstrasse. E. Frohne, President. Hermann Schnauss, Vice-President. M. Herrmann, Treasurer. Hugo Quatz, Hon. Secretary. All letters, &c., should be addressed to the President (E. Frohne), 24 Schumannstrasse, Dresden.

Fachverein der Photographen zu Berlin (Abtheilung des Deutschen Photogr. Gehilfen Verbandes).—Established December 1, 1893. Gustav Camphausen, President. Paul Schützman, Vice-President. Eduard Günther, Treasurer. Kuzelowsky, Secretary.

Haarlemsche Amateur Fotografen Club.—Established 1891. Place of Meeting, Haarlem Societeit Vereeniging. N. van der Sleen, President. Maurits H. Binger, Treasurer. Frans Huijsser, Secretary.

Münchener Photographische Gesellschaft.—Established 1879. Place of Meeting, München. Adalbert Werner, President. Otto Wernhard, Treasurer. E. Kieser, Secretary. Address of Society, Deutsches Haus, Carlsplatz, München.

Nymeegsche Amateur Fotografen Vereeniging, M. L.—Established 1893. Jacq. Kueppers, President. P. H. Heynen, Committee. F. van de Graaff, Treasurer. C. J. Baron van Hemert tot Dingshof, St. Annalaan 41, Secretary.

Continental Photographic Societies—*Continued.*

Photo-Club de Paris.—Established 1888. Place of Meeting, 44 Rue des Mathurins. Paris. M. Bucquet, President. E. Mathieu, Vice-President. M. Binder, M. Brémard, R. Demachy, P. Gers, P. Naudot, A. Darnis, C. Puyo, A. Toutain, Committee. H. Guérin, Treasurer. P. Bourgeois, 44 Rue des Mathurins, Paris, Secretary.

Photographische Gesellschaft.—Established 1861. Place of Meeting, Wien. Dr. J. M. Eder, K.K. Hofrath, President. Robert Sieger, Vice-President. Ludwig Schrank, K.K. Regierungsrath, Treasurer. Dr. J. Székely, Wien, I. Elisabethstrasse 2, Secretary.

Photographische Gesellschaft, Hamburg, Altona.—Established November 4th, 1873. Place of Meeting, Hamburg Jungfernstieg, 40. F. A. Dahlström, President. Willy Wilcke, Vice-President. C. Färber, Treasurer. S Hamann, Secretary. Address of Society, F. A. Dahlström, Hamburg, Zeughausmarkt.

Photographischer Verein zu Berlin.—Established 1863. Place of Meeting, Berlin, Architecten Vereinshaus. Paul Grundner, President. T. Reichard, Vice-President. T. C. Schaarwächter, Dr. S. Steinschneider, Paul Schückert, Hpsm. u. Dr. Himly, Dr. A. Miethe, Dr. A. Hesekiel, and F. Cornand, Committee. E. Martini, Treasurer. Director Schultz-Hencke, Berlin, S.W. Königgratzerstrasse, P.V., Secretary.

Société Française de Photographie.—Established 1854. M. Janssen, President. MM. A. Davanne (President), Ch. Bardy and Général Sebert (Vice-Presidents), Balagny, Gauthier-Villars, Gobert, Haincque de Saint-Senoch, Capitaine Houdaille, G. Rolland, Thouroude, Joseph Vallot, Léon Vidal, de Villecholle, Bordet (Librarian), E. Audra (Treasurer), S. Pector (Secretary), Albert Londe and Commandant Jolson (Assistant Secretaries), Council.

Société Genevoise de Photographie.—Established 1880. Meetings are held at Grand Mézel 1, Genève. Dr. Antoine Mazel, President, 1 Rue Centrale. Address all communications to the President.

Société Nantaise de Photographie.—Established 1881. M. du Hanlay, Lieut.-Colonel, President. M. Toublanc, Vice-President. Ch. Planté, H. Bureau, P. du Minehy, Committee. M. Tassain, Treasurer. Paul Crémant, Rue d'Alger, 13, Nantes, Secretary, and Pierre Courant, Assistant Secretary. Réunion le premier vendredi de chaque mois, au Cercle des Beaux-Arts.

Société Photographique d'Arcachon.—Established 1899. Place of Meeting, 10 Rue de Casino, Arcachon. Capitaine L. Billioque, President. M. St. Amand and Dr. A. Hameau, Vice-Presidents. M. de Marc, Treasurer. M. Dumora, Secretary.

Société Photographique Professionnelle.—Established 1878. Place of Meeting, Place St. Gervais, 6, à Genève. E. Dovaz, President. Charles Racine, Vice-President. Louis Barral, Treasurer. Antoine Chevalley, Siège de la Société Secretary.

Société Versaillaise de Photographie.—Established 1884. Séances de la Société les premiers Mardis de chaque mois à la Mairie à 8 heures et demie du soir. Maurice Bucquet, President. L. Ottenheim, Vice-President. Comité d'administration, Committee. M. Gavin, Treasurer. Jessé Curely, 20 Rue de Provence, Versailles, Secretary.

Verein zur Förderung der Photographie zu Berlin.—Established 1869. Martin Kiesling, Oberleutnant a. de, President. Dr. Brandt, Geheim. Oberregier. Rat, und H. Haberlandt, Vice-Presidents. Dr. W. Möhring, Dr. A. Hesekiel, Dr. L. Ellon, P. Loescher, W. Dieskau, Committee. Gustav Schmidt, Treasurer. Paul Hanneke, Berlin, W., Bülowstrasse, 99, Secretary.

Verein zur Pflege der Photographie und verwandter Künste.—Established 1875. Place of Meeting, Frankfurt-a-Main. Prof. Schmidt, President. H. Maass, Vice-President. C. Boettcher, Treasurer. Th. Haake (Messrs. Haake & Albers), Frankfurt-a/Main, Secretary.

AMERICAN PHOTOGRAPHIC SOCIETIES.

Agassiz Association, Manhattan Chapter (Photographic Section), New York.—Established 1881. Meetings held at 141 East Fortieth Street, New York City. C. F. Groth, President. C. Kromm, Vice-President. C. F. Groth, R. Kitchelt, E. B. Miller, W. S. Miller, H. T. Rowley, H. Brennich, F. C. Fruhan, Miss M. Leeson, and Miss M. Hargrove, Committee. W. S. Miller, Treasurer. E. B. Miller, 141 East Fortieth Street, New York City Corresponding Secretary.

Akron Camera Club.—Meetings are held at residences of members on the second Tuesday of each month. Edward A. Terrass, President. Henry Canfield, Vice-President. Frank Adams, Treasurer. Margaret Mitchell, 150 South Summit Street, Akron, Ohio, U.S.A., Secretary.

Albany Camera Club.—Established October 21, 1887. Meetings held at 72 Chapel Street, Albany, N.Y., U.S.A. General Robert Shaw Oliver, President. Charles W. Reynolds, Vice-President. The above officers, the Secretary and Treasurer, and George H. Russell, G. J. M. Goodwin, Howard P. Moore, Augustus Pruyn, L. H. Neuman, Charles H. Moore, S. C. Main, and Henry Popp, Committee. T. L. Carroll, Treasurer. Charles L. Palmer, 72 Chapel Street, Albany, N.Y., Secretary.

Amateur Photographic Association.—Established December 29, 1887. Meetings held at 916 Broad Street, Selma, Dallas County, Alabama. William S. Monk, President. S. A. Sexton, Vice-President. Miss Mary F. Keipp and Miss Mamie Ware, Committee. Captain S. Orlando Trippe, Selma, Dallas County, Alabama, Secretary.

American Institute (Photographical Section.)—Established 1859. Meetings held at 19 and 21 West Forty-fourth Street, near Fifth Avenue, New York City, U.S.A. Oscar G. Mason, President. Robert A. B. Dayton, Vice-President. James Y. Watkins, Treasurer. John W. Bartlett, M.D., F.R.P.S., 149 West Ninety-fourth Street, New York City, U.S.A., Secretary.

American Lantern Slide Interchange.—Established 1885. Meetings held at 361 Broadway, New York. F. C. Beach, General Manager. F. C. Beach, W. H. Cheney, W. H. Rau, John P. Zenner, Herbert F. Smith, Board of Managers. The Interchange consists of thirty American and Canadian Clubs, among which are exchanged a set of 100 selected lantern slides monthly for exhibition and educational purposes. Annual meeting is held in November of each year, when 2000 slides are examined and arranged in sets for use.

Atlantic City Photographic Society.—Established 1895. Meetings held at Atlantic City, N.J. Herbert N. Morse, President. Ferdinand Stodler, Vice-President. Leonard Dalger, Treasurer. Herbert Somers, 26 S. Indiana on Atlantic City, N.J., Secretary.

Bethlehem Photographic Society.—Established January, 1890. Meetings held at the residences of members. James E. Tatnall, President. Professor J. T. Hamilton, Vice-President. James E. Tatnall, Professor J. T. Hamilton, E. A. Rau, and R. P. Stout, Committee. E. A. Rau, Treasurer. R. P. Stout, 332 Market Street, Bethlehem, Pa., U.S.A, Secretary.

American Photographic Societies--*Continued.*

Birchwood-Beach Camera Club.—Established 1900. Meetings held at Harbert, Michigan, U.S.A. W. Bradford, President. M. L. Sizer, Harbert, Michigan, Secretary.

Boston Camera Club.—Established 1881. Meetings are held at 50 Bromfield Street, Boston, Mass., U.S.A. William R. Richards, President. F. S. Anable, C. H. Currier, and F. H. Manning, Vice-Presidents. The Officers and Dr. John Bryant, William P. Robinson, Dr. Percy E. Brown, Owen A. Eames, George H. Goodhue, and Walter B. Swift, Committee. Charles H. Chandler, Treasurer. Charles Hall Perry, 50 Bromfield Street, Boston, Mass., U.S.A., Secretary.

Bridgeton Camera Society.—Established 1890. Meetings are held at the Bridgeton Cumb. Company, New Jersey. Henry W. Scull, President. Sidney H. Ogden, Vice-President. Charles C. Woodruff, Emerson B. Gamson, and Frank E. Riley, Committee. Hugh L. Reeves, Treasurer. James Boyd Patter, Bridgeton, N.J., Secretary.

Brockton Camera Club.—Established April, 1894. Meetings are held at Room 1, Smith Building, Center Street. Robert E. Brayton, President. A. L. Evans and Dr. J. S. Thorndike, Vice-Presidents. The Officers, and C. H. Lawrence, G. W. Loring, S. H. Eaton, E. F. Stacey, and E. W. Farwell, Committee. C. L. Perry, Treasurer. E. W. Farwell, Wyman Street, Brockton, Mass., U.S.A., Secretary.

Brooklyn Academy of Photography.—Incorporated March 11th, 1887. Meetings held at 177 Montague Street, Brooklyn, N.Y. Dr. Sherman B. Price, President. William Bogart Walker and Alexander N. Cook, Vice-Presidents. Dr. S. B. Price, A. N. Cook, W. B. Walker, W. C. Daggett, H. E. Hayes, A. S. Ingram, C. E. Balmanno, William Arnold, J. M. Tallman, Samuel Baron, Edward Esmonde, W. T. Wintringham, Trustees. Alexander S. Ingram, Treasurer. Walter C. Daggett, Recording Secretary. H. E. Hayes, 177 Montague Street, Brooklyn, N.Y., Corresponding Secretary.

Brooklyn Institute of Arts and Sciences (Department of Photography).—Established 1887. Meetings held at 201 Montague Street, Brooklyn, New York. Charles H. Morse, President. William J. Bryant, Vice-President. Charles H. Morse (Chairman), J. W. Kent, W. J. Bryant, J. H. Norris, J. C. Oswald, William C. Peckham, F. A. Perret, A. C. Ruprecht, Mrs. C. H. Burdett, and Mrs. E. W. Maddren, Executive Committee. John H. Norris, Treasurer. A. C. Ruprecht, 379 Hancock Street, Brooklyn, New York, U.S.A., Secretary.

Buffalo Camera Club.—Established 1888. Meetings held at Franklin Street. John A. Stein, President. Harlow H. Boyce and H. Wilson Saunders, Vice-Presidents. John A. Stein, Harlow H. Boyce, H. Wilson Saunders, William G. Houck, John P. Zenner, Conrad L. Baer, Philip J. Knapp, Henry H. Gurnther, C. R. Knapp, James Savage, Louis F. Jansen, and Louis B. Hart. Conrad L. Baer, 1 Genesee Street, Buffalo, N.Y., Secretary and Treasurer.

California Camera Club.—Incorporated April 5, 1890. Meetings held at the Academy of Sciences Building, San Francisco, California, U.S.A. James W. Erwin, President. E. J. Dollard and W. B. Webster, Vice-Presidents. The Officers, and W. J. Street, J. W. Finigan, J. J. B. Argenti, and H. B. Madison, Directors. M. A. Greenlaw, Librarian. E. G. Eisen, Treasurer. H. B. Hosmer, 819 Market Street, Room 58, San Francisco, California U.S.A., Secretary. C. A. Lee Corresponding Secretary.

American Photographic Societies—*Continued.*

Camera Club, New York.—Established May 7, 1896. Meetings held at 3 West Twenty-ninth Street, New York City, U.S.A. John Aspinwall, President. J. Edgar Bull, Vice-President. Louis Schram, Harry B. Reid, John Beeby, Dr. Robert J. Devlin, Henry H. Mann, and Robert L. Bracklow, Trustees. William E. Wilmerding, Treasurer. Daniel J. Dowdney, Camera Club, 3 West Twenty-ninth Street, New York City, Secretary.

Camera Club of Mount Vernon.—Established 1895. Meetings are held at Studio of W. F. Slaight, Fourth Avenue, Mount Vernon, New York, U.S.A. Miss Mary E. Jennings, Secretary.

Camera Club of the University of Nebraska.—Established 1892. Meetings held at the Chemical Laboratory of the University of Nebraska, corner of Twelfth and R Streets, Lincoln, Neb., U.S.A. Miss Adaline Quaintance, P. O. Box 675, Lincoln, Neb., U.S.A., Secretary and Treasurer.

Camera Club of the University of Pennsylvania.—Established 1889. Meetings held at the College Hall, University of Pennsylvania, Thirty-sixth Street and Woodland Avenue, Philadelphia, Pa. Chas. R. Hinchman, 3655 Chestnut Street, Philadelphia, Pa., U.S.A., Secretary.

Camerads.—Established April 24, 1890. George K. Parsell, President. J. A. Blish, Vice-President. J. Arthur Blish, William Macom, D.D.S., George A. Veightmann, Council. Harvey Iredell, D.D.S., Lock Box 34, New Brunswick, N.J., Secretary and Treasurer.

Capital Camera Club.—Established May, 1891. Meetings held at 1010 F Street. Wallace C. Babcock, President. Dr. W. P. Herbst, Vice-President. W. C. Babcock, Dr. W. P. Herbst, Dr. W. E. Dieffenderfer, W. F. Peabody, E. B. Thompson, C. E. Fairman, E. M. Tolman, R. E. Logan, H. P. Simpson, E. J. Daw, J. M. Little, J. W. L. Dillman, and Miss K. S. Curry, Board of Directors. Dr. W. E. Dieffenderfer, Treasurer. W. F. Peabody, 918 L Street, or 1010 F Street, Secretary.

Central Camera Club, Brooklyn Y.M.C.A.—Established January 1, 1888. Meetings held at 502 Fulton Street, Brooklyn, N.Y. William H. Lowery, President. James P. Allen, Vice-President. Charles Kuhn, Treasurer. Rud. Gebeth, 19 Hudson Ave., Brooklyn, N.Y., Secretary.

Chautauqua Photographic Exchange Club.—Established 1888. C. M. Fitzgerald (Georgetown, California), President. Miss C. L. Pierce, Elmhurst, Riverside, Conn., U.S.A., Secretary and Treasurer.

Chicago Society of Amateur Photographers.—Established 1886. Meetings held at the Art Institute, Chicago. T. George Hislop, President. E. M. Murray, Vice-President. T. George Hislop, E. M. Murray, George H. Kittoe, Charles C. Cook, Marshall Wait, Dr. G. Gordon Burdick, Winfred S. Basley, Frederick K. Laurence, and E. W. Thomas, Board of Directors. George H. Kittoe, Treasurer. Charles C. Cook, The Art Institute, Secretary.

Cleveland (Ohio) Camera Club.—Established January 25, 1887. Meetings held at 5 Euclid Avenue on the first and third Tuesday evenings of each month at Eight p.m. The Annual Meeting is held on the first Tuesday evening in January, unless that Tuesday is the 1st of January, in which case it is deferred until the third Tuesday. William Ogler, President. Charles Potter, Vice-President. William Dorn, Treasurer. R. Dayton, M.D., 1202 Willson Avenue Cleveland, Ohio, U.S.A., Secretary.

AMERICAN PHOTOGRAPHIC SOCIETIES—*Continued.*

Colorado Camera Club.—Established October 26th, 1891. Meetings held at 329 Sixteenth Street, Denver, Colorado, U.S.A. Captain H. D. Smith, President. George L. Beam, Vice-President. Captain H. D. Smith, Major William Cooke Daniels, George A. Green, C. A. Yont, F. W. Lowery, Thomas A. Morgan, George L. Beam, Board of Directors. George A. Green, Treasurer. George L. Beam, 329 Sixteenth Street, Denver, Col., U.S.A., Secretary.

Columbia College (N. Y.) Amateur Photographic Society.—Established 1886. Meetings at Columbia College twice a month. Henry R. Taylor President. Dwight Taylor, Treasurer. H. M. Brookfield, Secretary.

Columbian College (Washington, D. C.) Camera Club.—Established 1888. Ordinary Meetings at Columbian College, Washington, D. C., every Wednesday afternoon. Allan J. Houghton, President. Edwin W. Ashford, Vice-President. W. B. Asmussen, Librarian. A. J. Houghton, Treasurer. Charles P. Spooner Secretary.

Columbus (Ohio) Camera Club.—Established October 6, 1884. Rooms, Y.M.C.A. Building. Regular Meetings, third Thursday of each month except July and August at half-past Seven p.m. Annual Meeting, third Thursday of December. John Field, President. C. H. Doty, Vice-President. C. S. Bradley, Treasurer. W. B. Kimball, 32 East Spring Street, Columbus, Ohio, U.S.A., Secretary.

Columbia Photographic Society.—Established November 24, 1893. Meetings are held at 1811 N. Broad Street, Philadelphia, Pa., U.S.A. Dr. G. J. R. Miller, President. P. A. Mitchell, First Vice-President. P. MacCaffray, Second Vice-President. Charles H. Smith, Harry Reeves, R. J. Hillier, G. J. Seiffert, Louis Renner, Frank D Long, N. E. Roedel, and William G. Ayres, Board of Directors. John S. Newman (Chairman), Charles H. Smith, and Louis Renner, House Committee. R. J. Hillier (Chairman), P. MacCaffray, and Harry Reeves, Finance Committee. N. E. Roedel (Chairman), J. de H. Angstadt, and John S. Newman, Membership Committee. Louis Renner (Chairman), W. G. Ayres, and R. J. Hillier, Library Committee. P. A. Mitchell (Chairman), John Dolman, and P. MacCaffray, Demonstration Committee. P. A. Mitchell (Chairman), Frank D. Long, and W. G. Ayres, Lantern-Slide Committee. William G. Ayres (Chairman), N. E. Roedel, and John Dolman, Outing and View Committee. Frank D. Long (Chairman), John S. Newman, Charles H. Smith, P. A. Mitchell, N. E. Roedel, Frank E. Elwell, jun., A. D. Boyer, H. R. Hillegas, jun., Louis Renner, and William G. Ayres, Exhibition and Entertainment Committee. Harry Reeves (Chairman), J. de H. Angstadt, Louis Renner, R. J. Hillier, Frank D. Long, John N. Reeve, and R. W. Peirce, Publication Committee. P. MacCaffray (Chairman), George R. Seiffert, G. S. Wilsey, John V. Alteneder, and E. Wager Smith, Technical Committee. John S. Newman, Treasurer. H. S. Anderson, 702 West York Street, Philadelphia, Pa., U.S.A., Secretary.

Corliss Art and Camera Club.—Established May 1, 1896. Meetings held at the State Street Corliss Memorial Building. J. S. McDaid, President. O. P. Gould and J. H. Wheeler, Vice-Presidents. Edgar F. Noyes, Treasurer. Miss A. B. Brown, Newburyport, Mass., c/o N. N. Jones, Secretary.

Cortland Camera Club.—Established 1895. Meetings held at Y.M.C.A. Rooms. L. M. Alexander, Lock Box 213, Cortland, N.Y., U.S.A., Secretary and Treasurer.

American Photographic Societies—*Continued.*

Delaware Camera Club.—Established 1891. Headquarters in its Club Rooms in the Equitable Building, Wilmington, Delaware. Regular Meetings are held on the first Thursday of each month. John M. Rogers, President. Miss Rachel S. Howland and Geo. A. Elliott, Vice-Presidents. John C. Phillips, 803 Franklin Street, Wilmington, Del., U.S.A., Secretary.

Detroit Camera Club.—Established February 17, 1897. Meetings held at 106 Miam Avenue. E. W. Sprague, President. A. D. Noble, jun., Vice-President. E. D. Roberts, O'Brien Atkinson, R. A. Field, J. E. Scott, F. B. Wood, A. D. Noble, W. S. Thomas, E. W. Sprague, W. E. Winckler, and Miss Davison, Executive Committee. W. E. Winckler, 106 Miami Avenue, Secretary and Treasurer.

Detroit Lantern Club.—Established January, 1891. Meetings held at the Museum of Art, Hastings Street and Jefferson Avenue, Detroit, Mich. Frank E. Kirby, President. A. D. Noble, jun., Director. D. Farrand Henry, 52 Woodward Avenue, Detroit, Mich., U.S.A., Secretary and Treasurer.

Elizabeth Camera Club.—Established 1893. Meetings held at 96 Broad Street. Jas. A. Knowles, President. A. P. Campbell, Vice-President. Dr. E. D. Frost, T. F. McCarty, J. G. Green, John Ball, E. W. Smith, A. P. Campbell, and A. N. Lakens, Committee. James A. Knowles, Treasurer John Ball, 96 Broad Street, Elizabeth, N.J., U.S.A., Secretary.

Frankford Camera Club of Philadelphia.—Established October, 1888. Meetings are held at Knight's Industrial and Beneficial Institute, Frankford, Philadelphia. B. Antrim Haldeman, President. John B. Lomax, Vice-President. Benjamin S. Thorp, Harry E. Crankshaw, John B. Lomax, Miss M. C. Shallcross, Miss M. R. Rover, and, *ex officio*, the President and Secretary, Committee. Harry E. Crankshaw, Treasurer. John M. Justice, 5016 Penn Street, Frankford, Philadelphia, Pa., U.S.A., Secretary.

Hartford Scientific Society (Photographic Section).—Established 1885. Meetings held at 65 Pratt Street, Hartford, Conn., U.S.A. C. R. Nason, Chairman. Louis W. H. Gradisky 80½ Ann Street, Hartford, Conn., U.S.A., Secretary and Treasurer.

Harvard Camera Club.—Established 1889. Headquarters, Harvard University, Cambridge, Mass. Annual meeting, June. Meetings monthly. Vernon Maunse, President. C. P. M. Rumford, Vice-President. Percy Emerson Brown, 11 Weld Hall, Cambridge, Mass., U.S.A., Secretary and Treasurer.

Haverhill Camera Club.—Established February 15, 1898. Meetings held at the Rooms Nos. 44 and 45 Daggett Building, Haverhill, Mass. Harry S. Baxter, President. Linwood O. Towne, Vice-President. Charles W. Glines, Ned C. Tozier, and Officers, Executive Committee. Alfred A. Ordway, E. H. Lufkin, and Linwood O. Towne, Exhibition Committee. Alfred E. Collins, Haverhill, Mass., U.S.A., c/o Haverhill Savings Bank, Secretary and Treasurer.

Hoboken Camera Club.—Established March 22, 1889. The Regular Meetings of the Club take place the first Tuesday of each month. The Board of Governors meet the third Friday of each month. The Annual Meeting of the Club takes place the first Tuesday in March, when the election of officers takes place for the ensuing year. All Meetings are held at 1036 Park Avenue, Hoboken, N.J. A. J. Thomas, President. C. Sudhaus, Vice-President. Three Trustees (W. Schrader, A. Beyer, and E. E. Wooley), all the Officers of the Club, the House Committee (F. A. Muench), and the Entertainment Committee, Board of Governors. William Allen, Custodian. H. J. Kultenbach, Treasurer. A. L. Smith, 1045 Bloomfield Street, Hoboken, N.J., U.S.A., Secretary.

AMERICAN PHOTOGRAPHIC SOCIETIES—*Continued.*

International Photographic Print Exchange.—Established May, 1893. A Postal Photographic and Exchange Club of twenty members. Walter Sprange, Beach Bluff, Mass., U.S.A., Secretary.

Irvington (N.J.) Art and Camera Club.—Established 1892. Meetings are held at Springfield and Union Avenues, Irvington, N.J., U.S.A. Edwin D. Harrison, President. F. H. Morrell, Vice-President. James Peckwell, jun., Treasurer. Melton Tompkins, Secretary.

Lancaster Camera Club.—Established May 15, 1895. Meetings held at Rooms, *Morning News* Building, Penn Square. William S. Gleim, President. W. A. Heitshu, Vice-President. Charles A. Sauber, Secretary and Treasurer. F. A. Demuth, 114 East King Street, Lancaster, Pa., U.S.A., Corresponding Secretary.

Louisville Camera Club.—Established 1888. Meetings held at North-east corner of Fourth Avenue and Jefferson Street, Louisville, Ky. R. L. Stevens, 1100 West Main Street, Louisville, Ky., U.S.A., Secretary.

Lowell Camera Club.—Incorporated 1892. Meetings held at Runels Building. Paul Butler, President. William P. Atwood, Vice-President. Frederick T. Walsh, Charles Runels, Lucius A. Derby, and A. H. Sanborn, Committee. A. H. Sanborn, Treasurer. George A. Nelson, 305 Summer Street, Lowell, Massachusetts, Secretary.

Lynn Camera Club.—Established January 1, 1888. Incorporated December 20, 1889. Regular Meetings, first Tuesday in each month. Annual Meeting, first Tuesday in January. All Meetings held at the Club House, 42 Broad Street. William H. Drew, President. J. N. Smith, Vice-President. W. H. Drew, J. N. Smith, J. W. Gibboney, A. J. Purinton, E. F. Bacheller, A. H. Carsley, W. B. Gifford, and W. A. Pevear, Committee. E. F. Bacheller, Treasurer. C. A. Lawrence, Club House, 42 Broad Street, Lynn, Mass., U.S.A., Secretary.

Memphis Camera Club.—Established 1893. Meetings held at the Y.M.C.A. Buildings. S. J. Latta, President. A. Wardle, Vice-President. S. J. Latta, A. Wardle, Geo. O. Friedel, M. Stewart, E. I. Pinnel, Directors. Geo. O. Friedel, 165 Gayoso Street. Memphis, Tenn., U.S.A., Secretary and Treasurer.

Minneapolis Camera Club.—Incorporated 1892. Meetings held at 309 Nicollet Avenue. H. E. Murdock, President. F. V. Haven, Vice-Presi-dent. President, Vice-President, Treasurer, Secretary, H. E. Peck, J. H. McEnary, Oscar Tucker, A. S. Williams, George W. Beach, and E. J. Kimball, Board of Directors. J. F. Schlimme, Treasurer. C. J. Hibbard, 323 Hennepin Avenue, Minneapolis, Minn., Secretary.

Mystic Camera Club.—Established June 4, 1889. Meetings held at 2 Ashland Street, Medford, Mass. John F. Wade, President. L. E. Shattuck, Vice-President. J. F. Wade, L. E. Shattuck, Will C. Eddy, Charles A. Clark, Everett Scammon, Edward B. Dennison, and J. F. W. Ames, Executive Board. Charles A. Clark, Treasurer. Will C. Eddy, 18 Summer Street, Medford, Mass., Secretary.

Newark (Delaware) Camera Club.—Established 1893. Meetings held at Newark, Delaware. Professor F. D. Chester, President. G. H. Powell, Vice-President. F. William Curtis, Newark, Delaware, U.S.A., Secretary and Treasurer.

AMERICAN PHOTOGRAPHIC SOCIETIES—*Continued.*

New Britain Camera Club.—Established 1892. Headquarters, 210 Main Street. Annual meeting, January. Meetings, second and fourth Tuesdays in each month. E. F. Porter, President. G. A. Reckard, Vice-President. F. W. Wood, 273 Main Street, New Britain, Conn., U.S.A., Secretary and Treasurer.

New England Lantern Slide Exchange.—Established 1890. Will. C. Eddy, 88 Marshall Street, Medford, Mass., U.S.A., Secretary.

New Orleans Camera Club.—Established December 17, 1886. Meetings are held at 712 Union Street, New Orleans, La. Hon. Bernard C. Shields, President. W. Gowland, Vice-President. William Grimshaw, Treasurer. M. V. Haulard, 1729 Bienville Avenue, New Orleans, La., U.S.A., Secretary.

Newton Camera Club.—Established 1893. Meetings held at the Club House, Brookside Avenue, Newtonville, Mass., U.S.A. F. O. Stanley, President. E. E. Snyder, Vice-President. Austin S. Kilburn, West Newton, Mass., U.S.A., Secretary.

New York Camera Club.—Established 1888. Meetings are held at 314 Fifth Avenue, New York. Samuel W. Bridgham, President. Franklin Harper, Vice-President. Robert J. Devlin, Treasurer. Chas. W. Stevens, M.D., 33 West Thirty-third Street, New York City, U.S.A., Secretary.

Norwalk Camera Club.—Established November 3, 1897. Mrs. W. V. Prinliss Dingan, President. Mr. H. W. Van Sciver, Vice-President. Harry Hall Finch, Bayview Avenue, So. Norwalk, Conn., U.S.A., Secretary and Treasurer.

Old Colony (*Rockland, Mass.*) *Camera Club.*—Established February 1, 1890. Meetings held at Arnold Building, Liberty Street. David Smith, President. Emery H. Jenkins, Vice-President and Treasurer. David Smith, Rockland, Mass., U.S.A., Secretary.

Omaha Camera Club.—Established 1894. Meetings held at 1312 Farnam Street, Omaha, Neb. W. Durnall, 1312 Farnham Street, Omaha, Neb., U.S.A., Secretary.

Oneida Camera Club.—Established March 1, 1894. Meetings are held at the Club Rooms, Post-office Building, Oneida, N.Y. B. S. Teale, President. George R. Hanson, Vice-President. Jacob Standt, Wesley Fisher, and C. M. Kingsbury, Committee. Albert Dygert, Treasurer. C. R. Baker, P.O. Block, Oneida, N.Y., U.S.A., Secretary.

Orange (*N.J.*) *Camera Club.*—Organized March 21, 1892. Meetings held on 5th and 20th of each month. F. H. Gould, President. D. S. Plumb, Vice-President. W. H. Cheney, Chairman of Lantern Slide Committee. E. J. Apgar, Chairman of House Committee. F. L. Fieger, Chairman of Membership Committee. T. J. Preston, jun., Chairman of Print Committee. Hermann Joerns, Chairman of Finance Committee. E. S. Butterfield, Treasurer. W. H. Mason, Secretary. Executive Committee composed of above nine persons.

Oregon Camera Club.—Established January 14, 1895. Meetings held at the Club Rooms, Oregonian Building, Portland, Oregon. Will H. Walker, President. F. C. Cover, Vice-President. Will H. Walker, F. C. Cover, Milton P. Goldsmith, F. A. French, and Hugo B. Goldsmith, Executive Committee. F. A. French, Treasurer. Milton P. Goldsmith, P.O. Box 93, Portland, Oregon, U.S.A. Secretary.

AMERICAN PHOTOGRAPHIC SOCIETIES—*Continued.*

Paterson Camera Club.—Established 1893. Meetings are held at 9 Lake Street. C. M. Giles, President. H. W. Gledhill, Vice-President. Wm. M. Moore, Treasurer. Chas. D. Cooke, Cooke Locomotive Works, Paterson, N.J., U.S.A., Secretary.

Photographers' Association of America.—Established 1880. Place of meeting in 1901, Detroit, Michigan. E. B. Core, President. D. D. Spellman, First Vice-President. Henry Klein, Second Vice-President. The combined Officers form the Executive Board. F. R. Barrows, Treasurer. J. George Nussbaumer, 500 Main Street, Buffalo, New York, Secretary.

Photographers' Association of Iowa.—Established 1889. Meetings held at Des Moines, Iowa. G. S. Coman, President. E. S. Frey, First Vice-President. W. H. Jacobs, Second Vice-President. Theo. A. Brown, Treasurer. J. R. Hall, Monroe, Iowa, U.S.A., Secretary.

Photographers' Association of Ohio.—Office of Executive Committee, Hamilton, Ohio. A. L. Bowersox, President. George H. Barnum, Springfield, Ohio, U.S.A., Secretary.

Photographers' Association, State of Missouri.—Established 1894. Meetings at St. Louis, Mo., 1899. George W. Curtiss, President. F. Tenby, jun., and C. Stewart, Vice-Presidents. Miss Belle Johnson, Treasurer. Fred Hammer, jun., 1545 Broadway, St. Louis, Mo., Secretary.

Photographic Club of Baltimore City.—Founded 1886. Meetings held at corner of Madison and Eutaw Streets, Baltimore City, Md., U.S.A. Frank T. Slothower, M.D., President. Percy M. Reese, Vice-President. Jordon Stabler, I. T. Norrlis, I. W. McAllister, F. T. Slothower, Percy. M. Reese, E. M. Barker, and J. P. Bigham, Committee. Enoch M. Barker, Treasurer. J. Plumer Bigham, corner of Madison and Eutaw Streets, Baltimore, Md., U.S.A., Secretary.

Photographic Society of Philadelphia.—Established 1862. Meetings held at 10 South Eighteenth Street, Philadelphia, Pa. S. H. Chapman, President. Walter P. Stokes and Samuel Sartain, Vice-Presidents. C. Yarnall Abbott, Prescott Adamson, John G. Bullock, George D. Firman, Caspar W. Miller, M.D., Charles R. Pancoast, William H. Rau, Robert S. Redfield, William H. Roberts, Benjamin Sharp, M.D., A. W. Robinson, and Henry Troth, Directors. William S. Vaux, Treasurer. Robert S. Redfield, Wayne, Pa., Secretary (*pro tem*).

Pittsburg Amateur Photographers' Society.—Organized 1885. Incorporated 1896. Meetings held at the Carnegie Library, Pittsburg, Pa., U.S.A. E. E. Keller, President. H. L. Christy, Vice-President. E. E. Keller, H. L. Christy, Mrs. S. A. Ammon, W. J. Boston, F. E. Gaither, F. T. Aschman, A. B. McVay, W. J. Hunker, and J. H. Hunter, Board of Trustees. W. J. Hunker, Treasurer. J. H. Hunter, 520 Greene Street, Pittsburg, Pa., U.S.A., Secretary.

Pittsfield Camera Club.—Established February 1, 1892. Meetings held at 768 North Street. J. F. Middleton, President. J. D. Roscoe, Vice-President. J. F. Middleton, J. D. Roscoe, J. E. Colton, J. H. Musgrove, A. N. French, C. G. Tompkins, and S. S. Stowell, Executive Committee. J. H. Musgrove, Treasurer. Jos. E. Colton, 768 North Street, Pittsfield, Mass., U.S.A., Secretary.

AMERICAN PHOTOGRAPHIC SOCIETIES—*Continued.*

Plainfield Camera Club.—Established 1889. Meetings held at the Club Gallery, Babcock Building. Walter H. Freeman, President. J. Hervey Doane, Vice-President. W. H. Freeman, Hervey Doane, H. H. Coward, Harold Serrell, and George H. Fountain, Board of Directors. H. H. Coward, City National Bank, Plainfield, N.J., Secretary and Treasurer.

Portland (Maine) Camera Club.—Established 1891. Meetings held at the Club Rooms. Stanley P. Warren, M.D., President. C. T. Whipple, Treasurer. Frederick Fox, jun., 66 Union Street, Portland, Maine, U.S.A., Secretary.

Postal Photographic Club.—Established April, 1885. Albert J. Le Breton (Washington, D.C.), President. F. O. Congdon, 120 Broadway, New York (Headquarters), Secretary and Treasurer.

Providence Camera Club.—Organized 1883. Incorporated 1889. Meetings held at 174 Weybosset Street, Providence, R.I. Christopher M. Lee, President. W. Penn Mather, Vice-President. O. L. Holt, Franklin W. Cummings, Frederick E. Brown, Mrs. E. E. Hill, John W. Auty, Arthur Winsor, R. Clyde L'Amoureux, and D. Howard Thornton, Executive Committee. Edmund A. Darling, Treasurer. David Bangs Pike, Court House, Providence, R.I., Corresponding Secretary.

Putnam (Conn.) Camera Club.—Established January, 1888. Headquarters at its Club Rooms, Putnam, Connecticut. Regular Meetings are held on the first Friday in each month. The Annual Field Day occurs on the first Wednesday in June. George E. Dresser, President. Edward F. Whitmore, Treasurer. Eric H. Johnson, Putnam, Connecticut, U.S.A., Secretary.

Rutland Camera Club.—Established October, 1893. Meetings held at 149 South Main Street, Rutland, Vt. Cornele G. Ross, President. Cornele G. Ross, N. S. Marshall, and V. F. Worcester, Committee. V. F. Worcester, 149 South Main Street, Rutland Vt., Secretary and Treasurer.

Sacramento Camera Club.—Established 1895. Meetings held at the Club Rooms, 504 J Street. Ferdinand Kohler, President. S. B. Nourse, Vice-President. Ferdinand Kohler, S. B. Nourse, W. G. Woods, R. P. Burr, R. B. Prideaux, W. E. Cogswell, and J. J. Gormley, Directors. R. P. Burr, Treasurer. W. G. Woods, 420 J Street, Sacramento, California, Secretary.

San Diego Camera Club.—Established May 12, 1900. Meetings held at the Opera House Building. Ford A. Carpenter, President. F. W. Kelsey, Vice-President. George W. Anderson (Entertainment), and Arthur Small (Outing Captain), Committee. J. E. Slocum, Treasurer. E. L. Rector, P.O. Box 138, Secretary.

Schuylkill Camera Club.—Established July 5, 1889. Meetings are held at the Q.O.O.F. Hall, 103 Market Street, Pottsville, Pa. A. W. Sheafer, President. Miss Elena Roads, Vice-President. The Officers are the Committee. W. L. Sheafer, Treasurer. B. S. Simonds, 1432 West Norwegian Street, Pottsville, Pa., Secretary.

Society of Amateur Photographers of New York.—Established March 10, 1884. Meetings are held at 113 West Thirty-eighth Street. C. C. Roumage, President. Dr. J. H. Stebbins, jun., Vice-President. Dr. J. T. Nagle, E. T. Birdsall, Albert Stetson, Louis T. Brush, C. W. Canfield, Harry Coutant, G. F. Basset, and Frank M. Hale, Board of Directors. W. E. Johnson, Treasurer. R. L. Bracklow, Recording Secretary. T. J. Burton, 113 West Thirty-eighth Street, New York City, U.S.A., Corresponding Secretary.

AMERICAN PHOTOGRAPHIC SOCIETIES—*Continued.*

Springfield Camera Club.—Established October, 1880. Meetings held at the Y.M.C.A. Building, Springfield, Mass., U.S.A. J. D. Roscoe, President. John W. Roberts, Box 1016, Springfield, Mass., U.S.A., Secretary.

Stevens (*Hoboken, N. J.*) *Photographic Society.*—Established 1880. Meetings held at the Stevens Institute, Hoboken, N.J. R. P. Jennings, President. — Ode, Vice-President. L. M. De Azeveda and Jos. Stehlin, Committee. Charles L. Wachter, Treasurer. E. C. Voorhees, Stevens Institute, Hoboken N.J., U.S.A., Secretary

St. Louis Camera Club.—Established 1885. Meetings held at 911 North Vandeventer Avenue. Walter H. Wilcox, President. M. T. Corwin, Vice-President. Charles M. Alexander, Chairman of the Lantern Slide Committee. H. B. Alexander, 4028 Westminster Place, St. Louis Mo., U.S.A. Secretary and Treasurer.

St. Louis Photographic Society.—Established December 1895. Meetings held in Y.M.C.A. Building, Grand and Franklin Avenue. Robert E. M. Bain, President. John B. Holman, Vice-President. Charles M. Alexander 4028 Westminster Place, St. Louis, Missouri, U.S.A., Secretary and Treasurer.

St Paul Camera Club.—Established May, 1899. W. Almont Gates, President. F. M. Saraway, Vice-President. B. J. Shipman, George S. Wilson, and H. A. Adams, Trustees. J. W. G. Dunn, Treasurer. H. A. Seppen, N. P. Railway Building, St. Paul, Minn., Secretary.

Sunny Side Camera Club.—Established October 10, 1891. Meetings held at 5900 South Broadway, St. Louis, Mo. Berthold W. B. Blumenthal, President. Edmund Broch, Vice-President. B. W. B. Blumenthal, William A. Britchner, Charles Hendemuth, and Algernon Blumenthal, Committee. William A. Britchner, 1235 South Broadway, St. Louis, Mo., U.S.A., Secretary and Treasurer.

Syracuse Camera Club.—Established 1886. Meetings held at University Buildings, Syracuse, N.Y. Louis S. Morgan, President. J. I. H. Wright, Vice-President. Louis S. Morgan, J. I. H. Wright, Dan H. Sweet, J. E. Bierhardt, H. T. Beach, H. F. Smith, H. D. Barto, and E. M. Pierce, Board of Directors. J. E. Bierhardt, Treasurer. Dan H. Sweet, 246 West Railroad Street, Syracuse, N.Y., Secretary.

Tech Camera Club.—Established September, 1889. Meetings, bi-monthly, at half-past seven p.m., in the Boynton Hall of the Polytechnic Institute, Worcester, Mass. Dark room and Printing room also at Boynton Hall. The purpose of the Meetings is to discuss photographic subjects and, as far as possible, to diffuse a knowledge of the science and art among the members of the Institute. The Executive Committee transact all business connected with the Club. H. J. Fuller, President. A. J. Smith, Vice-President. J. W. Higgins, 228 West Street, Worcester, Mass., U.S A., Treasurer and Secretary.

Technology Photographic Society.—Established 1893. Meetings are held at Massachusetts Institute of Technology, Boyleston Street, Boston, Mass. Herman A. Poppenhusen, President. Welles M. Partridge, Vice-President. President, Vice-President, Secretary, Treasurer, and Frederick Kleinschmidt, Committee. Arthur C. Lawley, Treasurer. E. Johnson Loring, Mass. Inst. Tech., Boston, Mass., U.S.A., Secretary.

Topeka Camera Club.—Established September 5, 1894. Meetings held at members' homes. F. M. Tuckerman, President. Ralph H. Gaw, Vice-President. W. E. Culver, Treasurer. F. M. Tuckerman, 34 Santa Fé Building, Topeka, Kansas, Secretary.

American Photographic Societies—*Continued.*

Trenton Photographic Society (*N.J., U.S.A.*).—Established January, 1898. Meetings are held at Rooms 11 and 12, 132 East State Street, Trenton, N.J Samuel S. Webber, President. James I. Woolverton, D.D.S., Vice-President. All Officers and three members, Trustees. W. C. Lawrence, Treasurer. Grant Castner, 51 Bayard Street, Trenton, N.J., U.S.A., Secretary.

Valley Camera Club.—Established November, 1896. Meetings are held at Phœnix, R.I., U.S.A. Ward E Smith, President. Ward E. Smith, F. J. Hoxie, J. Bancroft Lawton, Andrew Yorston, and Everet Nichols, Executive Committee. F. J. Hoxie, Treasurer. J. Bancroft Lawton, Phœnix, R.I U.S.A., Secretary.

Waterbury Photographic Society.—Established 1888. Meetings are held at Platt's Block, Waterbury, Conn. Oscar A. Ziglatzki, President. George F. Hodges, Vice-President. Henry T. Stedman, George H. Ward, and George Husker, Executive Committee. Henry T. Stedman, Treasurer. Hollyday Emery, Waterbury, Conn., U.S.A., Secretary.

Watertown (*N.Y.*) *Camera Club.*—Meetings held at 4 Paddock Arcade Watertown, N.Y. A. R. Wilson, President. George Mowe, Treasurer. C. A. Wilson, 2½ Public Square, Watertown, N.Y., U.S.A., Secretary.

Worcester Camera Club.—Re-established 1892. Meetings held at Walker Building, 405 Main Street, Worcester, Mass. Daniel F. Gay, 214 Main Street, Worcester, Mass., U.S.A., Secretary.

Young Women's Camera Club.—Established November, 1894. Meetings held at the Young Women's Christian Association Rooms, Minneapolis, Minn. Miss Mabel Jameson, President. Miss M. Bells Jeffery, Vice-President. Miss Minesoa Turnbull, Treasurer. Miss M. Eva McIntyre, 1833 Portland Avenue, Minneapolis, Minn., U.S.A., Secretary.

THE COPYRIGHT (WORKS OF ART) ACT (1862).

An Act for amending the Law relating to Coprright in Works oj the Fine Arts, and for repressing the Commission of Fraud in the Production and Sale of such Works.

WHEREAS by law, as now established, the authors of paintings, drawings, and photographs, have no copyright in such their works, and it is expedient that the law should in that respect be amended: Be it therefore enacted by the Queen's Most Excellent Majesty, by and with the advice and consent of the Lords spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

Copyright in Works Hereafter Made or Sold to Vest in the Author for his Life, and for Seven Years after his Death.

1. The author, being a *British* subject or resident within the dominions of the Crown, of every original painting, drawing, and photograph which shall be or shall have been made either in the *British* dominions or elsewhere, and which shall not have been sold or disposed of before the commencement of this Act, and his assigns, shall have the sole and exclusive right of copying, engraving, reproducing and multiplying such painting or drawing, and the design thereof, or such photograph, and the negative thereof, by any means and of any size, for the term of the natural life of such author, and seven years after his death; provided that when any painting or drawing, or the negative of any photograph, shall for the first time after the passing of this Act be sold or disposed of, or shall be made or executed for or on behalf of any other person for a good or a valuable consideration, the person so selling or disposing of or making or executing the same shall not retain the copyright thereof, unless it be expressly reserved to him by agreement in writing, signed, at or before the time of such sale or disposition, by the vendee or assignee of such painting or drawing, or of such negative of a photograph, or to the person for or on whose behalf the same shall be so made or executed, but the copyright shall belong to the vendee or assignee of such painting or drawing, or of such negative of a photograph, or to the person for or on whose behalf the same shall have been made or executed; nor shall the vendee or assignee thereof be entitled to any such copyright, unless, at or before the time of such sale or disposition, and agreement in writing, signed by the person so selling or disposing of the same, or by his agent duly authorised, shall have been made to that effect

Copyright not to Prevent the Representation of the Same Subjects in Other Works.

2. Nothing herein contained shall prejudice the right of any person to copy or use any work in which there shall be no copyright, or to represent any scene or object, notwithstanding that there may be copyright in some representation of such scene or object.

Assignments, Licenses, &c., to be in Writing.

3. All copyright under this Act shall be deemed personal or moveable estate, and shall be assignable at law, and every assignment thereof, and every license to use or copy by any means or process the design or work which shall be the subject of such copyright, shall be made by some note or memorandum in writing, to be signed by the proprietor of the copyright, or by his agent appointed for that purpose in writing.

Register of Proprietors of Copyrights in Paintings, Drawings, and Photographs to be kept at Stationers' Hall, as in 5 & 6 Vict., cap. 45.

4. There shall be kept at the Hall of the Stationers' Company, by the Officer appointed by the said Company for the purposes of the Act passed in sixth year of Her present Majesty, intituled *An Act to Amend the Law of Copyright*, a book or books, entitled 'The Register of Proprietors of Copyright in Paintings, Drawings, and Photographs,' wherein shall be entered a memorandum of every copyright to which any person shall be entitled under this Act, and also of every subsequent assignment of any such copyright; and such memorandum shall contain a statement of the date of such agreement or assignment, and of the names of the parties thereto, and of the name and place of abode of the person in whom such copyright shall be vested by virtue thereof, and of the name and place of abode of the author of the work in which there shall be such copyright, together with a short description of the nature and subject of such work and in addition thereto, if the person registering shall so desire, a sketch, outline, or photograph of the said work, and no proprietor of any such copyright shall be entitled to the benefit of this Act until such registration, and no action shall be sustainable nor any penalty recoverable in respect of anything done before registration.

Certain Enactments of 5 and 6 Vict., c. 45, to Apply to the Books to be Kept under this Act.

5. The several enactments in the said Act of the sixth year of Her present Majesty contained, with relation to keeping the register book thereby required, and the inspection thereof, the searches therein, and the delivery of certified and stamped copies thereof, the reception of such copies in evidence, the making of false entries in the said book, and the production in evidence of papers falsely purporting to be copies of entries in the said book, the application to the Courts and Judges by persons aggrieved by entries in the said book, and the expunging and varying such entries, shall apply to the book or books to be kept by virtue of this Act, and to the entries and assignments of copyright and proprietorship therein under this Act, in such and the same manner as if such enactments were here expressly enacted in relation thereto, save and except that the forms of entry prescribed by the said Act of the sixth year of Her present Majesty may be varied to meet the circumstances of the case, and that the sum to be demanded by the officer of the said Company of Stationers for making any entry required by this Act shall be one shilling only.

Penalties on Infringement of Copyright.

6. If the author of any painting, drawing, or photograph in which there shall be subsisting copyright, after having sold or disposed of such

copyright, or if any other person, not being the proprietor for the time being of copyright in any painting, drawing, or photograph, shall, without the consent of such proprietor, repeat, copy, colourably imitate, or otherwise multiply for sale, hire, exhibition, or distribution, or cause or procure to be repeated, copied, colourably imitated, or otherwise multiplied for sale, hire, exhibition, or distribution, any such work or the design thereof, or, knowing that any such repetition, copy, or other imitation has been unlawfully made, shall import into any part of the United Kingdom, or sell, publish, let to hire, exhibit, or distribute, or offer for sale, hire, exhibition, or distribution, or cause or procure to be imported, sold, published, let to hire, distributed, or offered for sale, hire, exhibition, or distribution, any repetition, copy, or imitation of the said work, or of the design thereof, made without such consent as aforesaid, such person for every such offence shall forfeit to the proprietor of the copyright for the time being a sum not exceeding ten pounds; and all such repetitions, copies, and imitations, made without such consent as aforesaid, and all negatives of photographs made for the purpose of obtaining such copies, shall be forfeited to the proprietor of the copyright.

Penalties on Fraudulent Productions and Sales.

7. No person shall do or cause to be done any or either of the following Acts: that is to say,—

First, no person shall fraudulently sign or otherwise affix, or fraudulently cause to be signed or otherwise affixed, to or upon any painting, drawing, or photograph, or the negative thereof, any name, initials, or monogram:

Secondly, no person shall fraudulently sell, publish, exhibit, or dispose of, or offer for sale, exhibition, or distribution, any painting, drawing, or photograph, or negative of a photograph, having thereon the name, initials, or monogram of a person who did not execute or make such work:

Thirdly, no person shall fraudulently utter, dispose, or put off, or cause to be uttered or disposed of, any copy or colourable imitation of any painting, drawing, or photograph, or negative of a photograph, whether there shall be subsisting copyright therein or not, as having been made or executed by the author or maker of the original work from which such copy or limitation shall have been taken.

Fourthly, where the author or maker of any painting, drawing, or photograph, or negative of a photograph, made either before or after the passing of this Act, shall have sold or otherwise parted with the possession of such work, if any alteration be afterwards made therein by any other person, by addition or otherwise, no person shall be at liberty, during the life of the author or maker of such work, without his consent, to make or knowingly to sell or publish, or offer for sale, such work or any copies of such work so altered as aforesaid, or of any part thereof, as or for the unaltered work of such author or maker.

Penalties.

Every offender under this section shall, upon conviction, forfeit to the person aggrieved a sum not exceeding ten pounds, or not exceeding double the full price, if any, at which all such copies, engravings, imitations, or altered works shall have been sold or offered for sale; and all such copies, engravings, imitations, or altered works shall be forfeited to the person, or the assigns, or legal representatives of the person whose name, initials, or monogram shall be so fraudulently signed or affixed thereto, or to whom such spurious or altered work shall be so fraudulently or falsely ascribed as aforesaid: Provided always, that the penalties imposed by this section shall not be incurred unless the person whose name, initials, or monogram shall be so fraudulently signed or affixed, or to whom such spurious or altered work shall be so fraudulently or falsely ascribed as beforesaid, shall have been living at or within twenty years next before the time when the offence may have been committed.

Recovery of Pecuniary Penalties.

8. All pecuniary penalties which shall be incurred, and all such unlawful copies, imitations, and all other effects and things as shall have been forfeited by offenders, pursuant to this Act, and pursuant to any Act for the protection of copyright engravings, may be recovered by the person hereinbefore and in any such Act as aforesaid empowered to recover the same respectively, and hereinafter called the complainant or the complainer, as follows:

In *England* and *Ireland*, either by action against the party offending or by summary proceeding before any two Justices having jurisdiction where the party offending resides:

In *Scotland*, by action before the Court of Session in ordinary form, or by summary action before the Sheriff of the County where the offence may be committed or the offender resides, who, upon proof of the offence or offences, either by confession of the party offending or by the oath or affirmation of one or more credible witnesses, shall convict the offender, and find him liable to the penalty or penalties aforesaid, as also in expenses; and it shall be lawful for the Sheriff, in pronouncing such judgment for the penalty or penalties and costs, to insert in such judgment a warrant, in the event of such penalty or penalties and costs not being paid, to levy and recover the amount of the same by poinding: Provided always, that it shall be lawful to the Sheriff, in the event of his dismissing the action and assoilzieing the defender, to find the complainer liable in expenses, and any judgment as to be pronounced by the Sheriff in such summary application shall be final and conclusive, and not subject to review by advocation, suspension, reduction, or otherwise.

Superior Courts of Record in which any Action is Pending may Make an Order for an Injunction, Inspection, or Account.

9. In any action in any of Her Majesty's Superior Courts of Record at *Westminster* and in *Dublin*, for the infringement of any such copyright as aforesaid, it shall be lawful for the Court in which such action is pending, if the Court be then sitting, or if the Court be not sitting then, for a judge of such Court, on the application of the plaintiff or defendant respectively, to make such order for an injunction, inspection, or account, and to give such direction respecting such action, injunction, inspection, or account, and the proceedings therein respectively, as to such Court or Judge may seem fit.

Importation of Pirated Works Prohibited.—Application in such Cases of Customs Act.

10. All repetitions, copies, or imitations of paintings, drawings, or photographs, wherein or in the design whereof there shall be subsisting copyright under this Act, and all repetitions, copies, and imitations of the design of any such painting or drawing, or of the negative of any such photograph, which, contrary to the provisions of this Act, shall have been made in any Foreign State, or in any part of the *British* dominions, are hereby absolutely prohibited to be imported into any part of the United Kingdom except by or with the consent of the proprietor of the copyright thereof, or his agent authorised in writing; and if the proprietor of any such copyright, or his agent, shall declare that any goods imported are repetitions, copies, or imitations of any such painting, drawing, or photograph, or of the negative of any such photograph, and so prohibited as aforesaid, then such goods may be detained by the Officers of Her Majesty's Customs.

Saving of Right to Bring Action for Damages.

11. If the author of any painting, drawing, or photograph, in which there shall be subsisting copyright, after having sold or otherwise disposed of such copyright, or if any other person, not being the proprietor for the time being of such copyright, shall, without the consent of such proprietor, repeat, copy, colourably imitate, or otherwise multiply, or cause to procure to be repeated, copied, or colourably imitated, or otherwise multiplied, for sale, hire, exhibition, or distribution, any such work or the design thereof, or the negative of any such photograph, or shall import or cause to be imported into any part of the United Kingdom, or sell, publish, let to hire, exhibit, or distribute, or offer for sale, hire, exhibition, or distribution, or cause or procure to be sold, published, let to hire, exhibited, or distributed, or offered for sale, hire, exhibition, or distribution, any repetition, copy, or imitation of such work, or the design thereof, or the negative of any such photograph, made without such consent as aforesaid, then every such proprietor, in addition to the remedies hereby given for the recovery of any such penalties, and forfeiture of any such things as aforesaid, may recover damages by and in a special action on the case, to be brought against the person so offending, and may in such action recover and enforce the delivery to him of all unlawful repetitions, copies, and imitations, and negatives of photographs, or may recover damages for the retention or conversion thereof: Provided that nothing herein contained, nor any proceeding, conviction, or judgment, for any act hereby forbidden, shall effect any remedy which any person aggrieved by such Act may be entitled to either at law or in equity.

Provisions of 7 *&* 8 *Vict., c.* 12, *to be Considered as Included in this Act.*

12. This Act shall be considered as including the provisions of the Act passed in the Session of Parliament held in the seventh and eighth years of Her present Majesty, intituled *An Act to Amend the Law relating to International Copyright*, in the same manner as if such provisions were part of this Act.

PRINCIPAL FOREIGN PHOTOGRAPHIC PERIODICALS.

FRANCE.

Bulletin de la Société Française de photographie.—Published by Gauthier-Villars et fils, quai des Grands-Augustins, 55, Paris.

Moniteur de la photographie.—Gauthier-Villars et fils, 55, quai des Grands-Augustins, Paris.

Bulletin du Photo-Club de Paris.—40, rue des Mathurins, Paris.

Photo-Gazette.—3, rue Racine, Paris.

GERMANY.

Photographisches Wochenblatt.—Potsdamerstrasse, 89, Berlin.

Deutsche Photographen Zeitung.—Weimar.

Photographisches Archiv.—E. Liesegang, Düsseldorf.

Photographisches Mittheilungen.—Prof. Dr. H. W. Vogel, 124, Kurfuerstein-Str. Berlin.

Der Amateur Photograph.—Dr. Paul Liesegang, Dusseldorf.

AUSTRIA.

Die Photographie.—17, Theresiengasse, Vienna.

Photographische Correspondenz.—Ludwig Schrank, Hauptstrasse, 9, Vienna, Austria.

Photographische Rundschau.—Charles Scolik, Paristengasse, 48, Vienna.

BELGIUM.

Bulletin de l'Association belge de photographie.—M. Ch. Puttemans, palais du Midi, Brussels.

Helios.—103, boulevard de la Senne, Brussels.

UNITED STATES.

Photographic Times.—423 Broome Street, New York.

Anthony's Photographic Bulletin.—591 Broadway, New York.

American Amateur Photographer.—239-241 Fifth Avenue, New York.

Photo American.—9 East 17th Street, New York.

Photo Beacon —The Beacon Publishing Company, Tribune Building, Chicago, Illinois.

Saint Louis and Canadian Photographer.—2700 Pine Street, Saint Louis, Missouri.

Wilson's Photographic Magazine.—853 Broadway, New York.

INDIA.

Journal of the Photographic Society of India.—Calcutta.

St. Veronica.—2 Marquis Street, Calcutta.

ITALY.

Bolletino della Società fotografica Italiana.—Via del Giglio, Florence.

Bolletino dell' Associazione degli Amatori di Fotografia.—25, Via Poli, Rome.

Dilettante di Fotografia (Il).—Milan.

Revista Scientifico-Artistica di Fotografia.—30, Via Principe Umberto Milan.

Il Progressio Fotografico —Via S. Maria Sogreta, Milan.

JAPAN.

Sashin Shimpo.

RUSSIA.

Bulletin mensuel de la Société Impériale russe, Section de la photographie. 2, Pantelemenskaja, St. Petersburg.

SWEDEN.

Fotografisk Tidskrift.—Albin Roosval, Stockholm.

SWITZERLAND.

Revue suisse de photographie.—40, rue du Marché, Geneva.

LIST OF THE PRINCIPAL TEXT-BOOKS ON PHOTOGRAPHY.

[THE books mentioned below are obtainable by order of all photographic dealers.]

Burton's Modern Photography. By W. K. Burton. 1*s.*

Early Work in Photography. By W. Ethelbert Henry, C.E. 1*s.*

Guide to Practical Photography. By T. N. Armstrong. 1*s.*

Instruction in Photography. By Sir William Abney. 10th Edition. Revised and Enlarged. 6*s.*

Science and Practice of Photography. By Chapman Jones. 3*s.* 6*d.* 2*s.* 6*d.*

Photography with Emulsions. By Sir William Abney, F.R.S. 3*s.*

The First Principles of Photography. By Clement J. Leaper. 5*s.*

Photo-ceramics. Photography applied to the decoration of Plaques, Pottery, and other Ceramic and Metallic Surfaces. By W. Ethelbert Henry, C.E., and H. Snowden Ward. 1*s.*

Photographic Enlargements. How to Make Them. By Geo. Wheeler. 1*s.*

Bromide Paper. Instructions for Contact Printing and Enlarging. By Dr. E. A. Just. 1*s.* 6*d.*

Bromide Enlarging and Contact Printing. By S. Herbert Fry. 6*d.*

Negative-making. By Sir William Abney, F.R.S. 1*s.*

Artistic Lighting. By James Inglis. 4*s.* 6*d.*

Instantaneous Photography. By Sir William Abney, F.R.S. 1*s.*

The Lighting in Photographic Studios. By P. C. Duchochois. Revised, with additional matter by W. Ethelbert Henry, C.E. 1*s.*

Chemistry for Photographers. By Charles F. Townsend, F.C.S., F.R.P.S. 1*s.*

Art of Retouching Negatives, and Finishing and Colouring Photograms. By Robert Johnson. 2*s.*

Art of Retouching. By J. Hubert. 1*s.*

Enamelling and Retouching. By Piquepe. Cloth. 1*s.*

Art and Practice of Silver Printing. By H. P. Robinson and Sir William Abney. 2*s.* 6*d.*

Platinotype: Its Preparation and Manipulation. By Sir William Abney and Lyonel Clark. 2*s.* 6*d.*

Lens Work for Amateurs. By Henry Orford. 3*s.*

Photographic Optics, A Treatise on. By R. S. Cole. 6*s.*

The Optics of Photography and Photographic Lenses. By J. Traill Taylor. 3*s.* 6*d.*

Optics for Photographers. By W. K. Burton. 1*s.*

Photographic Lenses. How to Choose and How to Use. By John A. Hodges. 2*s.*

The Studio and What to Do in it. By H. P. Robinson. 2*s.* 6*d.*

Practical Photo-micrography. By Andrew Pringle. 5*s.*

Photo-micrography. By E. J. Spitta. 12*s.*

Action of Light in Photography. By Sir William Abney. 3*s.* 6*d.*

Encyclopædia of Photography. By Walter E. Woodbury. 7*s.* 6*d.*

Dictionary of Photography. By E. J. Wall. 7*s.* 6*d.*

The Photographic Studio. A guide to its construction, &c. By T. Bolas. 2*s.*

Living Pictures. By H. V. Hopwood. 2*s.* 6*d.*

The Evolution of Photography. By John Werge. Personal chronological reminiscences of nearly half a century. 3*s.* 6*d.*

Photography: Its History, Processes, Apparatus, and Materials. By A. Brothers. 21*s.*

The Elements of a Pictorial Photograph. By H. P. Robinson. 3*s.* 6*d.*

Naturalistic Photography. 3rd Edition. Revised, enlarged and rewritten by Dr. P. H. Emerson. 5*s.*

Picture making by Photography. By H. P. Robinson. 2*s.* 6*d.*

Art Photography. By H. P. Robinson. 1*s.*

Practical Essays on Art. By John Burnet. 1. Composition. 2. Light and Shade. 3. The Education of the Eye. 2*s.* 6*d.*

Pictorial Effect in Photography. By H. P. Robinson. 3*s.* 6*d.*

Bichromate Salts in Photography. Six Lectures by Sir William Abney C.B., R.E., D.C.L., J. A. Sinclair, F.R.P.S., W. E. Debenham, J. D. Geddes, W. T. Wilkinson. 1*s.*

Stereoscope and Stereoscopic Photography. From the French of F. Drouin. 2*s.*

Wet-collodion Photography. By Chas. W. Gamble. 1*s.*

Art of Photographic Painting. By A. H. Bool. 1*s.*

ABC Guide to Autotype Permanent Photography. By J. R. Sawyer. With Autotype Frontispiece. 2*s.* 6*d.*

Ferric and Heliographic Processes. By G. E. Brown, F.I.C. 2*s.*

Photographic Reproduction Processes. By P. C. Duchochois. A treatise on Photographic Impressions without silver salts. 3*s.* 6*d.*

Tables of Conjugate Foci. For the Users of Photographic Lenses. Compiled and Explained by J. R. Gotz, F.R.P.S. 2nd Edition. 6*d.*

Photo-lithography. By George Fritz. Translated by E. J. Wall. 3*s.* 6*d.*

Photo-engraving. By H. D. Farquhar. 2*s.* 6*d.*

Photo-mechanical Processes. By W. T. Wilkinson. 5*s.*

A Treatise on Photogravure in Intaglio. By the Talbot Klic Process. By Herbert Denison, F.R.P.S. 4*s.* 6*d.*

Photo-aquatint and Photogravure. A Practical Treatise with many Illustrations, and Photo-aquatint Plate by the Author. By Thomas Huson, R.I. 2*s.*

Half-tone Process. On Zinc and Copper. By Julius Verfasser. 2*s.*

Half-tone Process on the American Basis. By Wm. Cronenberg. 2*s.*

Photographic and Photo-mechanical Printing Processes. By W. K. Burton. 4*s.*

Practical Radiography. A handbook of the applications of the X-Rays. With Illustrations. The Second Edition, entirely rewritten and up to date. By A. W. Isenthal and H. Snowden Ward. 2*s.* 6*d.*

Optical Projection. A Treatise on the Use of the Lantern in Exhibition and Scientific Demonstration. By Lewis Wright. 6*s.*

The Optical Lantern: For Instruction and Amusement. By Andrew Pringle, F.R.M.S. 2*s.* 6*d.*

Popular Photographic Printing Processes. By Hector Maclean, F.R.P.S. F.G.S.

PLACES TO PHOTOGRAPH.

[From the *Red Book* of the Affiliation of Photographic Societies.]

For permission to photograph the various buildings and public places mentioned below, application must be made to the authorities quoted.—

Cathedrals and Churches.—The Deans and Vicars.

Colleges of Oxford.—The Master or Dean.

London Parks and Open Spaces, &c., under the control of the L. C. C.—The London County Council, Spring Gardens, S.W. Permits are granted for twelve months.

The Royal Parks, &c., under the control of the Board of Works.—H.M. Board of Works, Whitehall, S.W. Permits granted for twelve months.

Kew Gardens.—The Directors. No photographing is allowed on Sundays, Christmas Day, Good Friday, or Bank Holidays.

Windsor Green Park and Virginia Water.—Captain Campbell, Holly Grove, Windsor Park.

Zoological Gardens, Regent's Park. Secretary, Zoological Society 3, Hanover Square, London, W.

Epping Forest, Highgate Woods, St. Paul's Churchyard, Burnham Beeches, Wanstead Park, Coulsdon Common, West Wickham Common.—Town Clerk, Guildhall, E.C.

British Museum.—The Chief Librarian. The application must specify the objects to be photographed, and the name of the photographer. Permits are only given to amateurs with respect to exhibited objects.

Botanical Gardens, Regent's Park.—The Secretary.

South Kensington Museum and Bethnal Green Museum.—The Secretary, Science and Art Department, South Kensington, S.W.

Houses of Parliament.—The Secretary, the Lord Chamberlain's Office, House of Lords, S.W.

Imperial Institute.—The Secretary.

Public Record Office.—The Secretary, Public Record Office, Chancery Lane, W.C.

Westmister Abbey.—The Chapter Clerk, the Sanctuary, Westminster, S.W.

Tower of London.—The Constable of the Tower.

The National Gallery.—The Director. Professionals only are allowed.

The Guildhall.—City Lands Committee, Guildhall, E.C.

Guildhall Art Gallery.—Library Committee, Guildhall, E.C.

Tate Gallery.—The Keeper, National Gallery of British Art, Millbank, S.W.

Halls of the City Companies.—The respective Clerks.

St. Bartholomew's Church, Smithfield.—Fee 2*s.* 6*d.*

Canterbury Cathedral.—The Seneschal. A fee of 5*s.* per day admits to roofs, tower, crypt, &c.

Colleges of Cambridge.—The Masters or Fellows, except for Trinity College where the book at Porter's lodge is signed.

Hastings Castle.—Fee 3*d.*

York Minster.—The Dean.

Rievaulx Abbey, Yorks.—Admission 1*s*. No restrictions.

Jervaulx Abbey, Yorks.—Admission 6*d*. No restrictions.

Selby Abbey.—Fee 6*d*., and a copy of each photograph.

Walsingham Priory.—H. Lee-Warner, Esq., at the house

Cheetham's Hospital and Library, Manchester.—The Master.

Haddon Hall.—At the Hall. Fee 6*d*. in addition to admission fee.

Hardwick Hall, Derbyshire.—The Duke of Devonshire.

Ludlow Castle, Shropshire.—Entrance Fee of 4*d*. covers photography.

Aston Hall, Birmingham.—Mr. Witworth Wallis, Art Gallery, Birmingham.

Little Moreton Hall, Cheshire.—Fee 1*s*.

Stokesay Castle, Shropshire.—Fee 6*d*.

Tintern Abbey.—The Warden. Fee 6*d*.

Chepstow Castle.—Admission 4*d*.

Raglan Castle.—Fee to Photographers 2*s*. 6*d*. in addition to Admission Fee 6*d*.

Fountains Abbey.—Fee 1*s*., covers photography.

Chatsworth House.—The Duke of Devonshire.

Warwick Castle.—The Estate Office. Fee to Photographers in addition to Admission Fee. Permit applies to courtyard and grounds. Special permission from the Earl of Warwick for interior.

St. Mary's, Warwick.—The Verger. Fee 2*s*. 6*d*.

Tewkesbury Abbey.—Canon Robinson. Special Fee to Photographers in addition to Entrance Fee.

Ramsey Abbey.
Beverley Minster. } The Rector.
Christchurch Priory.

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SUMMARY.

THE past year has been singularly lacking in photographic discovery of the first importance: indeed, as we turn back to the "Summary" of the ALMANAC for 1901, we are struck by the few really original departures in optics, chemistry, apparatus, and so forth that have since been made. It is, however, gratifying to note that photography, in its applications to science and industry, is spreading greatly. A marked growth of interest in tele-photography has been observable, and this has led us to select the subject for treatment in the Editorial Article of this ALMANAC.

The recent introduction of a stereoscopic Kodak by the Kodak Company should conduce to the spread of a knowledge of this branch of work amongst photographers. American-made photographic cameras continue to reach the British market in large numbers. Of novelty in lens construction there is little or nothing to record: but anastigmatic forms by American and German opticians other than Messrs. Zeiss, Goerz, Voigtländer, and Steinheil have been introduced. Self-toning papers and small cameras in great variety have been introduced to meet the needs of large numbers of amateur photographers with whom simplicity of procedure and apparatus are desiderata.

To our knowledge of colour photography hardly any original contributions have been made. Three-colour printing has apparently reached the stage of commercialism at last, but few of the popular reproductions that are being issued in such large numbers satisfy the critical in these matters.

A feature of the year was the formation, on proper bases, of a Professional Photographers' Association, numbering at the time of writing, five hundred members. It is anticipated that this Association will have great influence for good on professional photography. Keenness of competition and other causes have produced considerable perturbation in the photographic trade, but the marvellous hold which photography has acquired over all classes of the community has caused the industry, as a whole, to flourish.

The list of Societies given in an earlier part of this volume is larger than hitherto. If old ones die off, new ones spring up; and this, with the increased success of the various Exhibitions, representative institutions, and other agencies for gauging the progress of photography may, we think, be accepted as some indication that it forms so much a part of modern life that its decadence need not be seriously discussed.

M M

OBITUARY OF THE YEAR.

AMONGST the specially prominent photographers who have died since the publication of the last ALMANAC, the following may be mentioned :—

Samuel Highley (formerly Assistant Editor of THE BRITISH JOURNAL OF PHOTOGRAPHY and first Editor of this ALMANAC).

George Shadbolt (formerly Editor of THE BRITISH JOURNAL OF PHOTOGRAPHY).

George Mason.
Dr. Carl Grebe.
H. P. Robinson.
J. Harrison.
J. J. E. Mayall.
W. J. Stillman.
Valentine Blanchard.

Samuel Highley.

Mr. Samuel Highley, F.C.S., who died at the end of 1900, had long since passed out of the sight and mind of the photographic world, but nearly forty years ago he was an assistant-editor of the JOURNAL, and on the title-page of the ALMANAC for 1861, a tiny little volume which one could carry in the waistcoat pocket without courting the smallest discomfort, his name appears as the Editor. He interested himself in popularising optical projection for scientific purposes, and some of his articles on the subject, written at about the date mentioned, are so admirably expressed that, if reprinted now, they would pass muster as the work of a modern author newly emphasising the value and advantages of the lantern in the lecture-room. A full list of Mr. Highley's public contributions to general scientific knowledge lies before us in the form of a printed pamphlet. Besides photography, mineralogy and microscopy appear to have been amongst his subjects. He was a prolific writer and a man of varied tastes and occupations. Mr. Highley, who was in his 75th year, was Secretary of the Photographic Society of Great Britain in the year 1857, and in his time held many other scientific and journalistic offices. He passed a varied, busy, and useful life, and his record, if unfamiliar to the present generation of scientific journalists, was as creditable as it was full.

George Shadbolt.

The death last year at a very advanced age of Mr. George Shadbolt, removed from the scene one of the ablest and most scholarly editors which the JOURNAL has had during its forty-seven years' existence. Mr. Shadbolt occupied the Chair for about seven years between 1857 and 1864; and it is thirty-seven years almost to the day since the growth of his private business necessitated his retirement from photography and its journalism. With Mr. Shadbolt's disappearance THE BRITISH JOURNAL OF PHOTOGRAPHY, which had hitherto been issued fortnightly and consisted of eighteen pages, became a twelve-page weekly, and the publishing and editorial offices were removed from Liverpool to London. It was also at this time that the late Mr. J. Traill Taylor began an editorial association with the JOURNAL which, ceasing in 1879, was renewed in 1885, and continued until his death in 1895.

Mr. Shadbolt, who was one of the founders of the Photographic Society of London, now the Royal, devoted much attention to the optics of photographic lenses and to photo-micrography: and upon those themes his contributions to the JOURNAL during his editorship were valuable and frequent. He is also said to have been the first to take a micro-photograph, and, so far back as 1858, suggested the practicability of a triple lens "consisting of single convex lenses at each end of a short tube corrected by a concave of flint glass in a central diaphragm." He was a Vice-President of the North London Photographic Association before which body we find him reading a paper, in May, 1863, on "Open-air Portraiture."

The pages of the JOURNAL for 1864 testify to the great esteem in which Mr. Shadbolt was held by those with whom he was associated, and some months after his retirement he was the recipient of an elegant silver épergne in recognition of his services to photography. The following gentlemen formed the deputation from the Testimonial Committee at the presentation, which took place in July, 1865: Messrs. Shave, E. W. Foxlee, Melhuish, G. Wharton Simpson, J. Traill Taylor, Hill, H. P. Robinson, and Barnett. An editorial note in the JOURNAL of July 7, 1865, expressed admiration of Mr. Shadbolt's varied acquirements as a scholar and a man of science; sorrow that he should have felt compelled to resign a position the duties of which he filled with dignity and efficiency, and regret at his withdrawal from the field of photographic research, while yet in the full maturity of his mental powers. There are photographers still living who speak in terms of the highest appreciation of the late Mr. Shadbolt's great ability as an editor and a student of photographic science. The deceased gentleman's son, Mr. C. V. Shadbolt, it may be remembered, was keenly interested in baloon photography, in which he did good work. It was due to a balloon accident that he owed the tragic termination of a life that promised to be of the greatest usefulness.

George Mason.

Mr. George Mason passed away at his residence, Fern Tower, Kelvinside, Glasgow, on Thursday, June 5, aged 62. "George Mason of Glasgow," as he was universally known, was the head of the well-known photographic dealing business bearing his name which, formerly conducted in Sauchiehall-street, and latterly in Buchanan-street, may fairly be regarded as the parent stem from which many branches of photographic activity have sprung in the commercial capital of Scotland. Born in Alloa in 1839, he entered the service of the late Mr. John Spencer, of Glasgow, in 1863, and six years later became his partner. The house of John Spencer still exists, but now solely confines itself, we believe, to export business. It was in 1870 that Mr. Mason took over on his own account Mr. Spencer's general photographic dealing and retailing branch, and since that time has carried on business successively in Union-street, Sauchiehall-street (where he traded for twenty-four years), and, as we have said, latterly in Buchanan-street. It was once the legitimate boast of George Mason and Co. that they held the largest stock of photographic goods in Britain, and within our own recollection the firm had a very great sway indeed in the North of England photographic trade. Mr. Mason was at one time, we believe, on the Board of the North British Dry Plate Company, and of Messrs. G. W. Wilson and Co., Limited. He took up practical photography so far back as 1853, in which year he made stereoscopic transparencies popular in Edinburgh. His long experience of photography had endowed him with a rich store of historical knowledge of a kind not to be found in printed records, and as a raconteur of the doings of the photographic world in the days that are gone he was always greatly appreciated.

The late Mr. Mason was a Fellow of the Royal Photographic Society, and in 1893, at the Plymouth meeting, he occupied the Presidential chair of the Photographic Convention of the United Kingdom, of which he was an original member and always a warm supporter. Indeed, no Convention meeting was complete without his genial and inspiriting presence. He took part in the formation of the defunct Central Photographic Club, and actively supported the Photographers' Benevolent Association for several years. Endowed with very marked literary ability, he frequently contributed over the nom de guerre of "Mark Oute" to the pages of THE BRITISH JOURNAL OF PHOTOGRAPHY and its ALMANAC. To this day a volume of studies of photographic life, incident, and character of which he was the author, "Pictures in Black and White," is held in appreciative remembrance. He constructed fluent and graceful verse, always on his favourite theme, photography, and under a second nom de guerre of "Murray Russell," published several works of fiction. A shrewd man of affairs, the storm and stress of commercial life happily failed to wrest him from a love of literary elegancies.

Dr. Carl Grebe.

Born at Revel, March 8, 1868, Dr. Grebe had scarcely attained the age of 33 years. His father was teacher of mathematics at the Cassel Secondary School, where his son was also educated. In 1889 Dr. Grebe went to Marburg University, and subsequently to Berlin-Charlottenburg, where he studied under Dr. H. W. Vogel. He obtained his degree in 1892, and then opened an institute at Cassel with his friend Worlitz for the study of scientific photography. This project was soon abandoned, and after a short engagement with Messrs. Windscheid and Ranf, of Dresden, he went to the Royal Academy of Arts and Technical School at Leipsic, where he taught photo-mechanical processes. Count Vittorio Turati, of Milan, made his acquaintance there, and offered him an engagement, which he accepted. From 1895 to the autumn of 1898 a series of very interesting works from Dr. Grebe's pen appeared under Count Turati's name. Towards the end of 1898 he joined the staff of the Carl Zeiss Optical Works, and his last work on light filters appears in another part of this ALMANAC.

H. P. Robinson.

Mr. H. P. Robinson died on Thursday, February 21. One of the most active careers that British photography has witnessed started in 1852, when, at the age of 22, Mr. Robinson became an amateur photographer, and subsequently went into a studio at Leamington professionally. This was in 1857. A year afterwards, the long series of combination or composition pictures, with which his name was associated, began to make their appearance, and aroused the greatest interest in the photographic world. Of these the best known were "Fading Away," "Bringing Home the May," "When the Day's Work is Done," "A Merry Tale," "Wayside Gossip," "Day-dreams," "He never Told his Love," "A Chat with the Miller," "Pamela," "The Cuckoo," "Dawn and Sunset," "Carolling." Two distinct branches of work engaged Robinson's attention for exhibition purposes—viz., combination or composition subjects, in which all the constituent elements were photographically pieced together to form the narrative whole; and landscape with figures, illustrative of an incident or story. Of the first class of work, "Dawn and Sunset," produced about sixteen years ago, was probably the most successful; of the other, "Wayside Gossip" and "Carolling" strike the recollection as being conspicuously good examples. In combination or composition work, Rejlander was perhaps Robinson's only serious rival and competitor; in the "landscape with figures" order of production he had the field to himself. For full thirty years Robinson, in the pictorial photography of the time, had an extraordinary vogue, and the influence he exercised on contemporary photographic work was undoubtedly very great.

Mr. Robinson retired from active business as a professional photographer about twelve years ago; but his pen and his camera were seldom idle, and until within the last eighteen months or two years he enjoyed good health. To the JOURNAL for the years 1896 and 1897 he contributed a series of sprightly written "Digressions," which both interested and entertained a wide circle of readers. A prolific contributor to the old "Photographic News" and other periodicals, he was also the author of several books which for years past have had a steady sale amongst photographers. He was joint author with Sir William Abney of "Silver Printing," a useful text-book; whilst at one time his "Picture-making by Photography" and a companion work, "Pictorial Effect in Photography," were popular with those whom he influenced in their work. "The Studio, and what to do in it," was always a very favourite book of reference by professional photographers, and, perhaps, of all Mr. Robinson's literary productions, is the one likely to have the greatest and most abiding practical value. Many other books also owed their authorship to him, and most of them were translated into French and German, and published in America. His style of writing was clear, chatty, and agreeable, and in this department of his photographic work he enjoyed an unparalleled degree of appreciation at the hands of his professional brethren.

A member of the Council of the Photographic Society nearly thirty years ago, he subsequently became one of its Vice-Presidents. Last year he was elected an Honorary Fellow of the Society. In 1896 he was President of the Leeds Meeting of the Photographic Convention of the United Kingdom. The extinct Solar Club; the Field Club; and the Camera Club are also a few of the many other Societies to which he belonged at various times. The medal of the Photographic Society fell to him on many occasions, and in 1878 one of his photographs at the Paris Exhibition secured the International Gold Medal. At a period when photographic exhibitions were less frequent than they are now, Robinson's success was of constant occurrence, and, between 1860 and 1890, he was probably the recipient of about 100 medals. Judged from the standpoint of the competing photographer, Robinson must be allowed to have left himself no more worlds to conquer. In his profession, as an author and as an exhibitor, success and popularity rewarded his efforts, and his reputation was world-wide.

J. Harrison.

The late J. Harrison, of Leeds, was the inventor and maker of the once well-known head-rest bearing his name. He was one of the pioneers of photography in Leeds, having commenced business in that city in 1855, and had in his day a high local reputation as a photographer, being particularly successful with babies and young children. He began his career as a schoolmaster, and introduced a system of teaching the alphabet, receiving many testimonials from teachers and those connected with educational work. Through his invention and improvements on the old-fashioned type of rest, he will be remembered by those who lived in the photographic world of thirty years ago, when the dry plate and shutter were almost unknown. He gave up business some years ago, and has passed away at the age of seventy-five.

J. J. E. Mayall.

Probably the oldest photographer in England, if not the world, passed away last year in the person of Mr. J. J. E. Mayall, who had attained the great age of 91. Mr. Mayall was a contemporary of Beard, William England, and Claudet in Daguerreotypy nearly sixty years ago, and he achieved great success in this beautiful branch of photography during the decade or so that it enjoyed the patronage of the affluent classes. In the early sixties, when what is still termed the carte mania was at its height, Mr. Mayall was extraordinarily successful. The head of one of the London publishing houses has told us that their orders to Mayall at this time ran into hundreds of thousands for certain subjects—one, in particular, we believe, was a portrait of the present Queen Alexandra with one of her children. Mr. Mayall was thrice Mayor of Brighton, and had a photographic business in that town, where his name still survives. The late well-known microscopist, John Mayall, was his son, and another son is Mr. J. P. Mayall, the photographer. Of great ability and taste in his profession, Mr. Mayall was full of energy and vitality. In the early eighties, when past his three score and ten, we remember encountering him at his studio in Bond-street, and marvelling at his phenomenal energy and enthusiasm. The portrait work then leaving his studio would pass muster as first-class of its kind to-day.

W. J. Stillman.

The death of Mr. W. J. Stillman, which took place at his Surrey home on July 6, at the age of seventy-four years, removed from our midst one, the story of whose adventurous career includes the history of some of the most stirring episodes in the annals of Southern and Eastern Europe during the past century.

Mr. Stillman was personally known to many in the photographic world, and from an early period was an enthusiastic photographer. Little of his work has been seen in recent times, but, until a few years ago, he was a frequent exhibitor at the Pall Mall Exhibition. The series of photographs of ruined temples and other antiquities of Athens, produced by him in 1869, was certainly the finest work of the kind that had been done up to that time, and it has hardly been surpassed even now. Mr. Stillman joined the Photographic Society of Great Britain in 1885, and remained a member until his death.

Mr. Stillman was American by birth, having been born in the State of New York in 1828. His early intention was to become a painter, and, with a view of studying art, he visited England in 1850. Here he devoted himself to the study of the great masters. Among the friends he made were Ruskin, Millais, and Rossetti, and his style was greatly influenced by their teaching and example, so much so that on his return to America his work was distinctly pre-Raphaelite in character.

In 1851 Kossuth's tour in America in the cause of Hungarian freedom inspired Stillman with enthusiasm, and he placed his services at the disposal of the revolutionary cause. An opportunity was soon found him for active employment, and he was sent on a mission to Hungary to recover the Hungarian Crown jewels, which had been buried during the insurrection of 1848-9. He was unable to accomplish his object, owing rather to want of efficient co-operation on the part of those whose business it was to act with him than to any deficiency on his own part, but, though disappointed, he was not disheartened, and agreed to take part in a rising that was then being arranged to take place in Milan. Until the time was ripe he retired to Paris to renew his art studies. The Milan rising was abandoned, and Mr. Stillman returned to the United States, and occupied himself with painting.

It was at this period that Mr. Stillman commenced his connection with journalism. A paper was started by him, the title of which, "The Crayon," indicates its scope. It was not a financial success, but it was the means of bringing him into contact with Longfellow, Emerson, Lowell, Agassiz, and other notable literary men of his own country.

In 1861 Mr. Stillman was appointed United States Consul at Rome, which was then under the Papal dominion, and, later, exchanged his consulship for that of Crete. Here, his sympathies with the oppressed found full scope for activity, but his endeavours to obtain justice for the down-trodden Cretans from the Turkish rulers naturally brought him into notice, and exposed him to insult and even open hostility. The strain of the life obliged him to resign his appointment, and, moving to Athens, while still continuing his endeavours on behalf of the Cretans, he produced the series of photographs we have referred to.

A few years were then spent in England, and in 1875 Mr. Stillman commenced his connection with the "Times." His first work for the paper was as a correspondent in the Herzegovinian insurrection, and the subsequent campaigns. When opportunity occurred, he made journeys in Albania and Montenegro, and our Foreign Office was undoubtedly often influenced by his reports in the "Times." Subsequently he became "Times" special correspondent at Athens, and still later in 1886 at Rome. On his seventieth birthday he resigned his position, and retired to a quiet spot in the country.

Mr. Stillman will be remembered better as a journalist than as a photographer or a painter. His pursuits were so many that to excel in any one was difficult, nevertheless in all he made a reputation. In later years the photographic world has heard little of him; but, when photography was more difficult than it is now, he was one of its most honoured exponents, and a frequent contributor to the JOURNAL and this ALMANAC.

Valentine Blanchard.

With Valentine Blanchard, who died on Nov. 14 at Herne Common, near Canterbury, after a long and painful illness borne with the utmost fortitude, may be said to have passed away the last of that brilliant band of the sixties, who when the possibilities of pictorial portrait photography were denied and sneered at, did so much to raise its status and lay the foundation of what it has become to-day. Francis Bedford, O. G. Rejlander, T. R. Williams, James Mudd, H. P. Robinson, Robert Falconer, and now Valentine Blanchard are, it is to be feared, but names to the latter-day generation of photographers; but for all that their work is a reality and its influence exists in spite of the vagaries of fashion. Valentine Blanchard must have been an artist in whatever pursuit he chose to engage. His critical faculty was strong, and his judgment sound and acute. With the bent of his mind it is not at all surprising that, having served his apprenticeship to a printer at Wisbech (Blanchard's native town), he should cast printing aside and take up what then seemed a magical combination of science and art—Daguerreotypy. It was up-hill work in those days for every photographer, and Blanchard went through all grades, Daguerreotype, Talbotype, the glass positive, when collodion revolutionised everything, the carte-de-visite mania, and so on towards until Adam Salomon startled the world of portraiture by productions of which no one then had dreamed.

Always an original thinker and experimentalist, Valentine Blanchard early saw the artistic possibilities of the stereoscope and instantaneous photography. Despite the modern dry plates, no better rapid pictures—certainly no more artistic ones—have been produced than Valentine Blanchard's stereoscopic views taken in the sixties and early seventies. Cloud effects, heaving waves, the turmoil of traffic in the London streets—nothing came amiss to him, and when the labours, the difficulties, the uncertainties of the wet process are remembered, the results he obtained must be considered nothing short of marvellous. Valentine Blanchard, however, was essentially a portrait photographer, and when some half-a-dozen of the pictures of Adam Salomon (whose work made so great a sensation in the Paris Exhibition of 1867) were shown for the first time in London, Valentine Blanchard recognised their epoch-making value, and was the first to follow in the footsteps of the talented Frenchman. From this time henceforth Valentine Blanchard was an adherent of the forcible style of portraiture, and the breadth and dignity gained from the abolition of the white mount.

On the walls of the Whitefriars Club are to be seen to-day what is an absolutely unique collection of photographs, the portraits of the members including such men as Tom Hood, William Black, Charles Gibbon, Barry Sullivan, William Creswick. Interesting as many of these photographs are from the personalities represented, they are more interesting as pictures. The posing, the lighting, the balance of light and shade reach a very high standard, and as a whole they present a harmony of effect very remarkable. Many of these photographs are thirty years old, and, being on albumenised paper, do not do justice to the ngeatives. We believe these negatives are still in existence, and, if the old albumenised prints were replaced by platinotype or carbon, the genius of Valentine Blanchard would be shown in a manner little dreamed of by those who have only seen the pictures in their present stage. For years Blanchard was an exhibitor at the annual collection of the Royal Photographic Society, of which he was one of the Vice-Presidents, and some of his pictures, notably one entitled "The Zealot," created a sensation when it was discovered they were taken with a single lens. Blanchard, while not going so far as some of the later exponents of out-of-focus work, was always opposed to microscopic sharpness, and the diffusion of focus he gained by the use of a single lens was at once recognised as a step in advance towards the plane of art. Few men had a greater mastery over the intricacies of lighting the sitter, and, fertile of resources, and absolutely sure of the effect he wanted, he could produce admirable portraits in studios which would be the despair of ordinary men. Always an indefatigable technical worker, an earnest student of chemistry and a keen observer, photographers owe to him much that was novel and useful at the time, but which may now have been forgotten. His method of producing platinotypes in pure black resulted in some delightful examples, and a small exhibition of specimens some ten years ago attracted considerable attention. He was also the first to advocate making large transparencies from small negatives, the contact print practically becoming a paper negative. Some of these examples were so successful that they deceived many experts, who imagined they had been taken direct. As a man whose knowledge was ever at the disposal of those who sought it, Valentine Blanchard will always be remembered by those who came in contact with him. He had hosts of friends, professional and amateur, and his geniality, his courtly and kindly manner, his entire absence of self, endeared him to all.

Valentine Blanchard for some years previous to his death had given up professional photography, and his name was frequently to be seen among the judges at the various prominent photographic exhibitions. In this capacity his impartiality, his fearless independence, and his mature judgment were always appreciated, while the personal charm of his character made him welcome wherever he went. Valentine Blanchard at the time of his decease was but a few days short of his seventieth birthday.

INTRODUCTORY NOTES ON TELE-PHOTOGRAPHY.

BY THE EDITOR.

As this article will, to some extent, be a review of the principal English text-books on tele-photography, a list of them is given on this, the introductory, page, so that the reader may have before him at the outset the sources of information he should consult in detail, if the effect of the following compilation is to create in him a desire to make practical acquaintance with a branch of work that offers endless interest and pleasure to all photographers.

TELE-PHOTOGRAPHY: An Elementary Treatise on the Construction and Application of the Tele-photographic Lens. By THOMAS R. DALLMEYER, F.R.A.S., President of the Royal Photographic Society. 26 plates, 66 diagrams, 148 pages. London: Published by William Heinemann, 21, Bedford-street. Price 15s.

PRACTICAL NOTES ON TELE-PHOTOGRAPHY. By R. AND J. BECK. 68, Cornhill, Lonlon, E.C. 50 pages. 6d. post free.

TELE-PHOTOGRAPHY. Being No. 26 of "The Photo Miniature," a monthly magazine of Photographic Information. Edited by JOHN A. TENNANT. London: Dawbarn and Ward. Price 1s.

ELEMENTARY TELE-PHOTOGRAPHY. By ERNEST MARRIAGE, F.R.P.S. 49 illustrations, 118 pages. Price 3s. 6d. Published by Iliffe and Sons, Ltd., 3, St. Bride-street, London, E.C.

WONDERS OF THE TELE-PHOTOGRAPHIC LENS. By CHARLES E. SHEA. Reprinted from "The Gardeners' Chronicle," Dec. 8, 1900. Published gratis by Messrs. Dallmeyer, 25, Newman-street, Oxford-street, London, W.

CHAPTER I.

HISTORICAL NOTES.

TELE-PHOTOGRAPHY, the "art within an art" of the concluding decade of the last century, unquestionably owes its greatest stimulus to the work of Mr. Thomas R. Dallmeyer, F.R.A.S., the present President of the Royal Photographic Society, whose Progress Medal was awarded to him for the tele-photographic lens in the year 1895. Mr. Dallmeyer himself, in the preface to his book, which I shall notice in some detail in the next chapter, so carefully traces the development of the various systems employed for large direct views of distant objects, other than ordinary photographic lenses, that any historical treatment of the subject would necessarily be more or less an echo of his references, and therefore is not called for here. Some sentimental interest may, however, attach to the fact, unimportant though it must nowadays seem, that a former Editor of this ALMANAC, the late Mr. J. Traill Taylor, foresaw to some extent the practical value of an optical system which would, in effect, greatly lengthen the focus of the photographer's lens, without, at the same time, increasing the normal size of the camera. In an editorial article in THE BRITISH JOURNAL OF PHOTOGRAPHY for September, 1873, he wrote: "As lenses of very long focus necessitate the use of cameras of great length, the same object—that is, the production of an enlarged direct view—may be obtained (certainly on a plate of small size) by the use of a combination of lenses the optical centre of which shall be at a considerable distance outside the lens. Of this kind the common opera glass furnishes an example. An opera or field glass, if used as a camera lens, produces an enlarged image of objects in nature. We do not here refer to the use of the large 'object glass' of the instrument, but the combination of object glass and eye glass as used for looking through. An objective of this kind will produce an image having a considerable degree of amplification, this depending upon the power of the instrument. Although there is a fair degree of sharpness in the centre of the picture, it unfortunately does not extend to any distance from the centre. This, however, could be remedied, within certain limits, by the adoption of an eye-piece possessing a similar form to that of the negative combination of the old orthoscopic combination. We have an old opera glass which possesses in a remarkable degree the property of producing a large image with sharpness. Its peculiarity of construction consists in each barrel containing three lenses, each composed of three elements cemented together. The object glass is apparently a plano-convex, but is in reality a double convex of very unequal external curves; the centre lens is bi-concave, and the eye-piece plano-concave, each of these being achromatic in itself. The magnifying power is very great, and when used as a camera lens it gives quite a telescopic image." The same idea occurred to Taylor a few years later when, amongst the short Practical Notes of the ALMANAC for 1877, he inserted the following:—"It may not be generally known that, by means of an opera glass used as a camera objective, a greatly enlarged image of any view to which it is presented may be obtained. Owing to the shortness of the tube, and to the optical principles involved in the formation of a large image by means of an objective when used in conjunction with a concave eye-piece, this form offers advantages in the production of a directly magnified image not possessed by the ordinary telescope. . .

The form of 'tube,' when used as an objective for the camera, produced images of great sharpness in the axis, the sharpness being more extended than I have seen it with any other form. By means of this instrument I obtained an excellent and sharp photograph of the sun three inches in diameter." I remember seeing some of the negatives produced by the "small opera glass" referred to. Between this chance suggestion to use the uncorrected Galilean telescope for taking enlarged views of distant objects and the application by Mr. Dallmeyer of a corrected negative attachment to an ordinary lens (now known as the tele-photographic system), no comparison is, of course, made or suggested. The point is of some slight historical interest, however, for Taylor actually demonstrated that his idea was of some little practical value. It will be seen by Chapters 12 and 13 that the late Dr. Adolph Steinheil carried the principle a step further, and deals with the Galilean telescope as a corrected system for tele-photography.

CHAPTER II.

THE PRINCIPAL TEXT-BOOK ON TELE-PHOTOGRAPHY.

"To call attention to the scale in which objects are reproduced in the image by ordinary photographic lenses, and to show how this image may be subjected to direct enlargement or magnification before it is received on the photographic plate," is the aim of Mr. Dallmeyer's book. The non-mathematical reader of these few chapters will perhaps appreciate a brief outline of the method adopted by the author in developing his explanation of the principle of the tele-photographic lens.

1. The pin-hole camera is chosen to illustrate the formation of images of different sizes, and to furnish the basis of an inquiry into the perspective drawing given by lenses. Virtually, Mr. Dallmeyer treats the pin-hole as a simple optical system for leading up to a consideration of the essential properties of the tele-photographic lens, viz.. that it "acts as a lens of very considerable focal length, and with its aid photographs are produced that ought to be viewed from a distance equal to three or four times the larger side of the print," thus obviating, apparently, false rendering of perspective given by ordinary lenses.

2. In the chapter on "The Formation of Images by Positive Lens," the author proceeds to determine "the elements of a lens necessary for assigning the position and magnitude of the image of any object."

3. In the chapter on the formation of images by negative lenses he examines the manner in which rays of light are affected by negative lenses, with a view subsequently of using them in conjunction with positive lenses.

4. The formation of enlarged images "is considered in two parts:

(I.) by two positive lens systems; (II.) by a positive system and a negative system combined—or the tele-photographic lens, which the author conceives to act in two ways—(a) "as a complete positive system of variable focal length, and therefore capable of producing images of different size of a given object at any definite distance from it"; (b) "as consisting of two separate parts, a positive lens of definite focal length, whose function is to form a real image of definite size at a definite distance from the object, combined with a negative lens of definite focal length, whose function is to magnify the image given by the positive lens." This is by far the most important, as it is the most exhaustive chapter in Mr. Dallmeyer's book; it may be said to elucidate the whole action and effect of the tele-photographic lens in practical use. Diagram 43 should be particularly instructive to the photographer. It illustrates how, "with a camera extension of only 9 inches from the negative lens we can obtain an image of the same size as that given by an ordinary lens of 24 inches focal length, requiring this (24 inches) length of camera." In this explanation the ordinary photographer will probably consider that Mr. Dallmeyer concentrates the pith of tele-photography.

5. The importance of the diaphragm as affecting rapidity, diffraction, covering power, equality of illumination, distortion, perspective, "depth of focus," is treated in great detail.

6. The chief practical applications of the tele-photographic lens; descriptions of each of the principal negative systems adopted by English and Continental opticians; working data, with illustrations of suitable cameras, conclude the treatise. The whole-page balloon, geological architectural, natural history, Alpine, marine, eclipse, solar and portrait tele-photographs that are in the book supply, with the explanatory data, a series of the most remarkable illustrations of the rendering of near and distant objects on the photographic plate.

As it is the object of these chapters to induce readers of the ALMANAC to practically interest themselves in tele-photography, I have thought that a reference to the salient points of the principal text-book on the subject would assist the end in view. Besides being a classic in the literature of the subject, Mr. Dallmeyer's book is a practical guide of the highest value and reliability.

CHAPTER III.

SOME USES OF TELE-PHOTOGRAPHY.

THE addition of a negative, or, as it may in fact be styled, a supplementary lens system to a positive photographic lens of the rectilinear, anastigmatic, or portrait type, places in the hands of the photographer a range of power not yet so fully appreciated as it might be. In the book noticed in the preceding chapter the author emphasises the point that the value of the tele-photographic lens is as great, if not greater, than in photographing near as well as distant objects. "It will be found to possess invaluable properties wherever lenses of great focal length are required to produce large images on the one hand and for rendering improved perspective drawing in any given scale of near objects on the other. This latter effect is brought about by the fact that a greater distance intervenes between a tele-photographic lens and a comparatively near object (as in portraiture) than that required when using a lens of ordinary construction of the same focal length." In other words, leaving the question of perspective out of consideration for the moment, tele-photography admits of the direct production of enlarged images on both near and distant objects, in virtue of the fact that the optical system not only allows of a considerable range of magnifying power, but at the same time of a variety of focal length.

Let us enumerate some of the uses to which this lens has been applied:—

1. Distant Mountain Views. [At an Alpine Club Photographic Exhibition there was shown a print from a tele-photographic negative of the Himalayas taken from a standpoint 90 miles distant.]
2. Studio Portraiture [see Dallmeyer *ante*].
3. Outdoor Portraiture. [An example of this kind of work was shown by Dr. Emerson at the Exhibition of the Photographic Salon in 1893.]
4. Distant Architectural Subjects. [Mr. F. S. Dobbins in "The Photo-Miniature" gives some examples.]
5. Architectural Detail [Marriage].
6. Alpine Photography [vide Mr. C. E. Shea, quoted in the next chapter].
7. Photography on the Battlefield. [The well-known war correspondent, Mr. H. C. Shelley, was the first, and I believe so far the only, successful user of the tele-photographic lens for this purpose.]
8. Natural History Studies [The Messrs. Kearton; Mr. R. B. Lodge].
9. Instantaneous and Hand-camera Photography.
10. Balloon Surveying [Captain Mario Moris].
11. Astronomical Work [see Steinheil *ante*].
12. Medical, Surgical, and Scientific Work [see Dallmeyer].

It is obvious that this list could be extended; but the practical photographer can, without further suggestion, realise the value of the tele-photographic lens in many branches of work other than those enumerated.

CHAPTER IV.

WONDERS OF THE TELE-PHOTOGRAPHIC LENS POPULARLY EXPLAINED.

In his little pamphlet, "The Wonders of the Tele-photographic Lens," Mr. C. E. Shea, whose skilfully taken Alpine tele-photographs were such an admired feature of the last members' Exhibition at the Camera Club, shows many comparative results taken with ordinary and tele-photographic lenses which illustrate this point. I can recommend Mr. Shea's results to the study of the beginner, for whose information I take the liberty of quoting a few of the practical remarks illustrating his admirable photographs:—"It was in the nature of things," he says, "inevitable that as one aim of science appears to be the annihilation of space—the bringing of far-off things near to us—that it should occur to the mind of some one that as we can do so many things from afar it was highly desirable that we should add to our powers that of photographing objects at distances before believed to be impossible. And, so, an able scientist, Mr. T. R. Dallmeyer, applied himself to the solution of the problem, and in 1891 presented the world with the tele-photographic lens; in other words, an optical system comprising within small weight and compass the magnifying capacity of a powerful telescope. It has been to many a matter for wonder that, brought out so long ago as 1891, so little advance has been made, at least in this country, in the practical use of this truly remarkable invention. The striking photograph of Mont Blanc, by Mons. Boissonnas, of Geneva, and the admirable balloon tele-photography of the Italian military engineers, serve to again remind us—as we may one day learn in submarine warfare—that the foreigner is already reaping while we are but sowing, or, perhaps, only sleeping. That the lens is very difficult to use with full success is beyond question, but, with every difficulty admitted, it is not easy to understand the little progress made amongst us. Much was expected in connection with the employment of the tele-photo lens, especially in balloon photography, in the present South African war; but the results appear to have been relatively disappointing. To photograph 'penny-button' heroes at a distance of a few hundred yards seems scarcely a fit, or, at any rate, sufficient employment of this powerful instrument; but, obviously, many of those who took the lens with them to South Africa omitted to take the absolutely necessary preliminary step of fully mastering the difficulties of the lens before they started."

The Tele-photo Lens in Mountaineering.

"To the mountaineer the tele-photo lens is of the highest value. A mountain peak has to be prospected with a view to a 'new way up.' Possibly (as is the case in the example next given) a wide valley intervenes between the mountain which it is desired to photograph and ground of a similar, or at all approximate, level. To take a view from the absolute foot of the mountain itself would, even with the aid of the 'rising front,' necessitate a tilting of the camera by which the whole mountain would be, photographically, 'brought down' and distorted. What the result is of taking the view across the valley with the ordinary lens is shown in a picture of the Croda da Lago, in Tirol, taken from the grounds of the Faloria Hotel. Comparéd with this, we have a view of the same mountain, taken from the same place, with the high-power tele-photographic lens. One can see in this picture every detail of the climb, and the negative has stood enlargement up to 21×13 inches."

DIFFICULTIES OF HIGH POWER WORK.

"That the lens is difficult to work—at least, at great distances and high magnifications—is beyond question. One of the first difficulties necessarily arises from the rapid diminution of light (based on the law of the squares of the degree of linear amplification) due to increased magnification. Three linear magnifications mean nine superficial, with one-ninth of the normal light to focus by. Seven linear mean forty-nine superficial, with a like reduction of light, while the ten linear magnifications leave us with but one-hundredth of the accustomed light; and be it remembered that we must focus with the stop which we intend to use, and also with the isochromatic screen (as it is between the lenses) in situ, if we use isochromatic plates, thus further diminishing the light. Another difficulty arises from the use of the necessarily high-power focussing glass, which so magnifies the granulation of the ground glass focussing screen that the absolute sharpness of the image thereon remains in doubt. The best way to focus appears to be to throw the image out of focus equally each way, and then, by means of the focussing screw on the lens, seek to hit the mean between the two extremes. The resulting picture has always proved with us far sharper than we ever seemed to see the image on the screen. Several makers, English and Continental, now supply the tele-photo attachment, but our experience of the working of the Dallmeyer lens seems to show that it leaves nothing to be desired in the way of further efficiency. The firm's system of double focussing, i.e., first with the positive as against the negative element of the system, and then with the whole system (positive and negative as one unit) in relation to the focussing screen is admirable. It permits of that 'suddenness' of focus which the last-named mode of focussing alone fails to provide. The degree of magnification attained is directly connected with the camera extension, but the camera extension necessary with the telephoto system is very small compared with the resulting equivalent focus of the objective. The camera extension necessary for distant objects may readily be found for any magnification by setting the focussing screen at a distance from the negative lens equal to the focal length of the negative lens itself, multiplied by the magnification desired, less 1, e.g., for a magnification of diameters, using a 3-inch negative, the camera back must be set at a distance of (4 – 1) = 3 × 3 or 9 inches, regardless of the focal length of the positive element, whatever that may be. At short distances, and up to three or four linear magnifications, no great difficulties are encountered. It is beyond these limits, and as the higher rates of magnification are reached, that the real difficulties arise."

The difficulties pointed out by Mr. Shea are necessarily inseparable from high-power work, but they should not deter the tele-photographer from undertaking the rendering in his negatives of objects situated at nearer distances which do not demand such accuracy of fine adjustment as large magnifications. In my own practical experience, which so far has been limited, however, I found no difficulty in obtaining quite sharp images of objects ten miles off (for example, the Bass Rock from a point on the Haddingtonshire Coast) by the compound method of focussing mentioned by Mr. Shea, and trusting to the eye for the "fine adjustment." But I worked at low power, of course: a six-inch positive and a moderate power negative attachment giving, with a camera extension of 10 inches (approx.), an equivalent focal length of 24 inches (approx.).

In outdoor work where direct enlarged views of objects situated, let us say, from 400 to 1000 yards from the camera, are desired, low-power magnification by tele-photography is simply and easily managed. It is this kind of work which will, no doubt, be chiefly popular with amateurs, who have not the advantage of being able to use their cameras in countries where a clear atmosphere is the rule, and not the exception.

CHAPTER V.

EXPOSURE NOTES IN TELE-PHOTOGRAPHY.

Those of my readers who did me the honour to read the compilation in last year's Almanac on Exposure Tables and Exposure Meters will appreciate my motive in including in this series of chapters the following extract on the calculation of tele-photographic exposures from No. 26 of "The Photo Miniature" referred to on page 699. The author of the article in question works out on common data a series of tables of exposures with ordinary lenses, for use in the United States, and then applies the results to magnified images obtained with tele-photographic systems. It is obvious that any of the well-known English meter and plate systems in use are applicable in like manner to the calculation of tele-photographic systems in countries other than the United States. First of all, exposures with ordinary lenses are taken into consideration :—

Now comes the really important question, where trouble is most likely to arise and discouragement to follow: the question of exposure. As we have already said, in referring to this difficulty, the problem has been practically solved by means of a lengthy series of experiments. Further experiments may make some modification in the tables of exposure to be presented, but there is not likely to be any very great variation. We may use an exposure meter to ascertain the normal exposure under ordinary circumstances, or we may make use of a table of ordinary exposures, or we may have recourse to both. On our way to the place where the tele-photographs are to be made, we may work out the right exposure according to the table, and on arriving at the destination compare it with the figures given by the exposure meter. This double labour is well repaid by the results. Inasmuch as the multiplication, especially for the higher magnification, is so great, a slight error is magnified correspondingly, so it pays to be cautious and to use several bases of comparison. If the meter could be absolutely depended upon, doubtless that would be all-sufficient, but as a little dampness may make it slow, and the result would be a great over-exposure, one needs to have something with which to test it. I have, therefore, prepared the following table of normal exposures, for use with the ordinary photographic lens, and a second table giving the number of times the ascertained exposure under ordinary circumstances is to be multiplied for a tele-photograph. The first table is based upon half a dozen different tables, tested in various ways; the second is the result of a series of wholly original experiments.

TABLE A—NORMAL EXPOSURE WITH ORDINARY PHOTOGRAPHING LENSES.

General Rule: Multiply the time given (fraction of a second) in the first table by that given in the second, then by that of the third, and finally by that of the fourth.

Table 1.—For an exposure, using stop No. 4 U.S. (f-7.7), with the most intense light and fastest plates :—

MONTH.	HOUR OF THE DAY.				
	A.M.—6	7	8	9	10
	P.M.—6	5	4	3	2
April to August	$\frac{1}{10}$	$\frac{1}{16}$	$\frac{1}{20}$	$\frac{1}{32}$	$\frac{1}{48}$
March and September	$\frac{1}{2}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{24}$	$\frac{1}{32}$
February and October		$\frac{1}{4}$	$\frac{1}{12}$	$\frac{1}{20}$	$\frac{1}{24}$
January, November, and December		1	$\frac{1}{6}$	$\frac{1}{10}$	$\frac{1}{12}$

Table 2—Character of the Object.

Sky, clouds, etc.	⅛
Snow, distant scenes	¼
Very open landscapes	½
Ordinary landscape, trees, etc.	1
Dark objects, including portraits taken out of doors	2

Table 3—Character of the Light.

Intensely bright	1
Rather bright light	1½
Faint shadows, slightly dim	2
Dull	3
Very gloomy	4

Table 4—Speed of the Plate.

Seed 27, Cramer Inst. Iso.	1
Seed 26, Carbutt Eclipse, Cramer Banner	1¼
Carbutt, Ortho. 27	1½
Seed 23, Cramer Iso. Med.	2½
Carbutt Ortho. 23	4
Cramer Iso. Slow	12
Carbutt B. 16	20

Example.—It is 10 o'clock of a morning in June; we are taking a well-lighted object in an ordinary landscape, the light is bright, we shall use a medium isochromatic plate and the ordinary positive photographic lens (not a tele-photo combination). Ten o'clock in June is one-forty-eighth second; multiply this by 1 for the ordinary landscape, then by 1½ for the bright light, and this by 2½ for the medium isochromatic plate, and the result given is about one-twelfth second for the No. 8 stop. Of course, if we use a smaller stop, we multiply in the well-known way of doubling the exposure for each halving of the area of the lens diaphragm. This simply furnishes us a basis for further calculations.

In considering the proper exposure for the tele-photo combination, we may approach our end by two ways. We may find the rule of photographic optics governing the matter, or we may experiment until, by successful results, we reach a conclusion. If one result does not agree with the other, then we may look for the explanation of the matter.

Were I sure that the reader had by him a copy of last year's ALMANAC for reference, there would be no necessity to reprint the foregoing chapter in extenso. However its presence here serves the useful purpose of leading up to a system of calculating tele-photographic exposures from those given with ordinary lenses, which the author works out in the next chapter.

CHAPTER VI.

RELATION OF MAGNIFICATION TO EXPOSURE.

Reference has been briefly made, proceeds the article quoted in the preceding chapter, to the fact that the tele-photo combination accomplishes precisely the same results, as far as the magnified image goes, as a positive lens having a much greater focal length than the combined lenses of a tele-photo combination. Let us, first of all, reduce this to precise statement.

The rule for finding the focal length of a positive lens equal to that of a given tele-photo combination is this: multiply the focal length of the positive lens by the magnification. Thus, with an eightfold magnification, using a positive lens of seven inches focal length, the tele-photo combination would, with a bellows extension (ascertained according to the rule previously given for the purpose), of 24½ inches, be equivalent to a positive lens of a focal length of 56 inches. This would be a lens 9 inches in diameter, in a mount nearly a foot long, and requiring a tremendous camera; the whole would be a waggon-load. The accompanying table exhibits this matter of comparative focal lengths and the bellows-length needed for various magnifications. The calculation is based upon a tele-photo combination of a 7-inch positive with a negative lens of 3½ inches.

Magnification.	Camera Extension Required:	
	With tele-photo comb.	With ordinary lens.
Eightfold	24½ inches	56 inches
Sevenfold	21 ,,	29 ,,
Sixfold	17½ ,,	42 ,,
Fivefold	14 ,,	35 ,,
Fourfold	[illegible] ,,	28 ,,

This table does much more than show the great gain in the saving of bulk and unwieldiness; it gives us a basis of calculation in the matter of exposure. The exposure for an eightfold magnification, using the combination described, must be precisely the same as we would use were we working with a lens of 56 inches focal length. Or, to arrive at the same result in another way, if we have a symmetrical doublet with a focal length of 7 inches, and if either element alone has double the focal length of the doublet, every one knows that a double exposure is required for this doubling of the focal length, and that the stop must be doubled in size to equal that used with the doublet. So we reach the rule that in tele-photography the exposure must be the multiplication of the exposure required under ordinary circumstances with the positive lens only, by the square of the magnification. For example, if with the ordinary photographic lens one would, with any given stop, make an exposure of one second, with an eightfold magnification using the same positive, he would require 64 seconds.

This is the rule, but it needs much modification. It seems as if distance diminishes the necessary exposure far beyond one's expectations, or as if the diffusion of light incident to distance work is more than one would look for. And there are other factors which still further modify the result. My experiments have resulted in so great a modification of the conclusions of this rule as to astonish me, while affording cheering encouragement in proportion to the diminution of the exposure, longer, at best, than one wishes.

TABLES FOR USE WITH TELE-PHOTO COMBINATIONS

(Positive and Negative Lenses).

Rule: Multiply the normal exposure required by ordinary photographic lenses by the figures given.

Note: The figures are ratios, and not seconds.

Table 1.—For objects 1000 feet distant or less, using no colour-screen:

Magnification	8	7	6	5
Dark objects in shadow	64	49	36	25
Bright objects in shadow	48	36	27	18
Bright objects in good light	32	24	18	12
Bright objects in intense light	16	12	10	8

Table 2.—For objects more than 1000 feet distant, using a colour-screen and isochromatic plates. If no screen is used, the exposure will be, of course, but one-fourth the length of time when the screen is used.

Magnification	8	7	6	5
Dark objects in shadow	64	49	36	25
Dark objects in good light				
Bright objects in shadow	50	38	28	20
Bright objects in good light	36	28	21	15
Bright objects in intense light	22	18	14	10

For example, referring back to a previous calculation of a normal exposure, where we found that for an ordinary landscape, at 10 o'clock on a June morning, the light being bright and a medium isochromatic plate being used, about one-twelfth second would be needed, if we used a No. 8 stop. Out of that landscape we select one object, a great granite tower, for instance, with the light shining fairly upon it. It is three or four miles away. There is a little smoke from the near-by railroad station and some haze, so we use the colour-screen. We wish to make an eightfold magnification. We find the ratio for a bright object in a good light to be 36, and we multiply our one-twelfth second by that figure, and the result is three seconds.

Of course, it is impossible for one to provide here for every possible contingency. There are differences of definition and other matters touching the personal equation in work of this sort that make it absolutely impossible for one individual to furnish a guide for another with unerring assurance. These tables, however, will be found so near to the settlement of the problem of exposure that any tele-photographer can readily furnish his own modifications after a little experience. Usually, at first, it will be better for one to make several exposures above and below the standard given, carefully noting data and, after development, results.

The above is especially concerned with long-distance work. For convenience the table for work at closer range has been put with the other. The division point of a thousand feet is arbitrarily fixed, and it is suggestive and not absolute.

CHAPTER VII.

MR. ERNEST MARRIAGE'S BOOK ON TELE-PHOTOGRAPHY.

The excellent work which the well-known tele-photographer, Mr. Ernest Marriage, has been doing for some years invests the text-book on the subject which he has recently published with considerable value, and, as it entirely abstains from dealing with the theoretical side of the subject, and appeals direct to that very large class which only concerns itself with practical applications, its "public," as the term goes, is a wide one. Some sixteen pages of tabular matter at the end of the book are of the greatest possible use, as they include calculations relating to exposures; a comparison of "ordinary" and "tele-photographic" lens apertures; magnifications and rapidity at various extensions of the camera in English and metrical measures; and tele-photographic rapidity at various magnifications. I have read three other sections of the book with special interest: those headed "The Camera and its Accessories," "Architecture," and "The Tele-photography of Animals." In this last chapter there are reproductions of tele-photographs made in the twenty-fifth of a second by the aid of a tele-photo system applied to Messrs. Voigtlander's positive lens, f-3; equivalent aperture f-9.5. It is frequently supposed that tele-photography is necessarily dependent on time exposure in all circumstances: an error which this reference may do something to destroy. Indeed, hand-camera tele-photography is seriously deserving of more attention at the hands of apparatus makers and amateurs. Quite recently, at one of the French photographic societies "a specimen of Bellieni's jumelle was shown with a tele-photo attachment. M. Bellieni's jumelle is a hand camera of the opera-glass type. The lenses with which it is fitted have a focus of 4¼ to 5¼ inches. A very light aluminium tube has been provided for adapting the instrument to its new work, and it is fitted with a specially calculated Zeiss negative lens, which enlarges the image five to six diameters. This is equivalent to the use of a lens of about 21 to 26 inches focus. The lens supplied with the camera is removed, screwed on the front of the aluminium tube, which in its turn is screwed in the flange on the front of the camera. The finder has also been adapted to give a corresponding image."

To the first two of the three sections of Mr. Marriage's book which I have named, I would specially direct attention: his advice about apparatus is very sound, and his experiences in the tele-photography of architectural subjects large and valuable, and I am much indebted to him for his permission to draw upon the latter in succeeding chapters for the benefit of ALMANAC readers.

It would not be fair further to quote from a book, the perusal of which, while compiling this article, has given me great pleasure. I conclude my references to it by cordially recommending it as fulfilling its objects, which, in Mr. Marriage's words, "are to show those who are unacquainted with tele-photography the advantages gained by its practice, to help them in the selection of apparatus, and to assist tele-photographers who often have no guide by which to determine their exposures."

Here I might endorse the advice given by Mr. Marriage and other tele-photographers that in stand-camera photography perfect rigidity and steadiness of the whole system of apparatus is absolutely essential. Much of the work is necessarily done at long exposures, and thus tremor of any kind is fatal to fine definition.

I prefer a hood to a focussing cloth over the ground glass screen out of doors, as if there be the least wind about the cloth offers an easy resistance to aerial interference. These things do not apply to indoor work, but the photographer who first takes up tele-photography out of doors must be prepared to find that he must pay closer regard to small details than is called for in the case of ordinary landscape or architectural work with lens systems of the usual type.

A word of recommendation to the opticians. Lens mounts for tele-photography should be as far as possible of aluminium. I have two systems before me as I write. They have both been in use on a tourist camera. The one chiefly mounted in brass weighs 14½ ounces —the other entirely mounted in aluminium nine ounces only—a very important difference. A special front and attachment were required for the first, as the comparatively great weight was too strong for the brass catches that held the panel in position; the aluminium system, on account of its lightness, needed no such special provision. The reduction of weight is a matter of importance to users of small cameras for tele-photography.

CHAPTER VIII.

ARCHITECTURAL TELE-PHOTOGRAPHY.*

SETTING UP THE CAMERA AND FOCUSSING THE IMAGE.

FROM the interesting book, a review of which forms the substance of the previous chapter, I take, by kind permission of the publishers, Messrs. Iliffe, and the author, Mr. Marriage, the following hints on architectural tele-photography. But, as I have already pointed out, the full chapter deserves to be studied in its entirety in company with the excellent explanatory illustrations. I generally find (remarks Mr. Marriage) that if there is any tele-photography to be done at all, there are a good many plates to be exposed, and that therefore it is well when setting up the camera before a building to include the tilting table, and, as it can be shut quite flat with the camera in position, it does not interefere with ordinary exposures. After selecting the subject and the point of view, the first step is to set up the tripod. Do not attempt to tilt the camera by altering the legs of the stand; arrange these so that the base of the tilting table is perfectly level; endeavour also to have the camera as firmly supported as possible. In the absence of wind, it will be found that the camera is less liable to move when the legs of the tripod are fairly close together. A breeze necessitates having a wider base; the legs should then be arranged so that one points windwards. It is sometimes an advantage to tie the legs of the tripod together with a continuous piece of string.

The camera is now supported upon the tilting table and tripod, with the tele-photo lens in place. Rack out the camera to the minimum extension (measuring always from the back of the negative lens to the plate) required for the plate that is to be used. Focus the lens, by the pinion on the mount, on any subject that may be about the same distance from the camera as the piece of detail which is to be tele-photographed. Then swing the tilting table and camera round on the tripod head until the lens is pointing towards the object. By means of the tilting table tilt the camera until the image of the object is visible about the centre of the screen, and fix the table in this position. Focus the image by means of the pinion on the lens. If the details are now satisfactory in point of size and position on the plate, adjust the camera back until it is perpendicular, and re-focus upon the centre of the plate, More generally, the image on the screen is not the most suitable size; if it is too small, all that has to be done is to increase the extension of the camera, and focus now and again with the lens until the desired end is attained. If, on the contrary, the whole of the object is not visible on the screen, the camera must be racked in until, on focussing as before with the lens, it is all included. When the camera extension is reduced, care must be taken that the plate is properly covered. There is no such risk when increasing the camera draw; there is then, however, greater danger of vibration, because of the greater surface exposed to wind, greater spring in the camera framework, and also a longer exposure in which vibration may be set up.

Focussing the Image.

There are two difficulties that combine to make focussing awkward under some conditions. In the first place the equivalent aperture of a tele-photo lens is not so large as that of most ordinary lenses. If the photographer is using his rectilinear for the positive lens with an aperture of f-8, then with a moderate number of magnifications, say four, this is reduced to f-32. On a well-lit object it is comparatively easy to focus with f-32, or a smaller stop, but in a diffused light, which is more suitable than strong sunlight, the process requires care, whilst interior work is always attended with more or less risk. If it is possible to affix a piece of large print upon the object, this will prove of very material assistance; 2 in. square of black paper pasted on to a piece of white card would answer the purpose equally well; some people might even go so far as to include a diagram or measure of this kind (say, 2 in. black squares with 2 in. spaces) in the negative. Secondly, it is not quite so easy to focus with a lens of long focus; slight movements of the screen have less apparent effect than in the case of lenses of ordinary focal length. With tele-photo lenses at a moderate magnification the camera screen may be racked in and out to a considerable extent without much visible effect, and the golden mean of sharp focus is not easily found in this way. Under ordinary conditions it is better to focus with the rack and pinion on the tele-photo lens itself; a slight turn of that pinion has a more marked effect upon the sharpness of the image. The question whether it is desirable to focus the tele-photo lens with the particular stop that is going to be used for making the exposure depends to a great extent upon the positive lens in use. Some lenses when used in the ordinary way require to be focussed separately for different stops if the sharpest definition is required. If such a lens is used for the positive of a tele-photo lens, it becomes necessary to focus with the stop which will be used for the exposure. It is generally more convenient to focus with the full aperture of the lens, and then to stop down until sufficient depth of focus is obtained. I have worked with a number of different types of tele-photo lenses, and found little or no need for departing from this method.

The next point to consider, after the image is focussed and arranged upon the screen, is the stopping down of the front or positive lens. If the camera has been tilted, and the back swung appreciably, it is certainly wise to use a small stop, f-22 or f-32, but, if there has not been any great departure from normal conditions, probably f-16 will be ample. With a fair number of magnifications there is less need for stopping down than when the lens is used to almost the full limit of its covering power. The depth of focus required by any particular object must be obtained by stopping down, as in the use of ordinary lenses, but it will not be necessary to quite the same extent. Theoretically, the equivalent aperture of the tele-photo lens should not be less than f-71 ("Tele-photography," T. R. Dallmeyer, p. 86), but practically this limit need not be considered. I have repeatedly worked with such lenses at f-120 to f-160, and obtained negatives with sharp definition.

CHAPTER IX.

THE LIGHTING OF ARCHITECTURAL TELE-PHOTOGRAPHS.

Mr. Marriage continues: "The necessity for tilting the camera, and consequent swinging of the camera back, may often be partially removed by taking the tele-photograph from a greater distance, and obtaining increased size by increased magnification. Swinging the back must always be considered an evil, demanding the use of a smaller stop than would otherwise be required, and, unless the subject be on a level with the camera, the advantage of being further away from it is great, if the pictorial result of the tele-photograph is taken into account. The drawbacks are the extra extension of the camera, which can be somewhat lessened by the use of a negative lens of shorter focus, and the unavoidable diminution in the equivalent aperture of the lens due to increased magnification.

There are certain circumstances under which tele-photography is unlikely to give pleasing prints, where an ordinary photograph, perhaps on account of its smaller size, may be satisfactory enough. If an object is principally in deep shadow, and with small brightly lit portions, an ordinary photograph will give a fair idea of the subject considered as part of a general view; but the tele-photograph increases the area of the shadow, and the print is black and flat, with insufficient proportion of high light to give relief. It may be that fuller exposure would remedy the defect; at any rate it could do no harm. I remember particularly two sets of negatives which are examples of this variety of failure. The first is of some details on Strasburg Cathedral, upon the north side; the general view, taken with an 8 in. lens, received twenty seconds' exposure, with stop f-44, and the negative is as good as one could wish; the tele-photographs, taken with an equivalent aperture of about f-46, were exposed from eighty to a hundred seconds. Generally speaking, the correct exposure for a tele-photograph is the duration required by the ordinary lens multiplied by the square of the magnification, assuming that the stop in the positive lens is the same in each case. With these examples, allowing for the use of f-11 in the case of the tele-photographs as against f-44 for the ordinary work, the correct exposure should have been twenty-two seconds, yet, although the tele-photographs received four or five times this proportionate exposure, under-exposure seems to be indicated by the results. The second set referred to is of carvings in red sandstone round the north door of the cathedral at Freiburg in Breisgau—the same fault is here observable; possibly in this case the colour of the stone may have contributed towards under-exposure.

"The tele-photographer should avoid taking subjects with a strong light behind them; for example, detail on the corner of a building with bright sky for a background. Under such conditions there is pretty certain to be a fogging action over the whole plate, sometimes accompanied by a circular band of increased density on the side of the plate opposite to the highest light, and the image of the object in the negative will be poor and flat. This applies more or less to all subjects in which the view taken by the front or positive lens would include the very brightly lit portion; but the further that high light is from the centre of the field the less will be the resulting evil. Sometimes the difficulty can be conquered by moving the camera to a point further away from the object until surrounding buildings, owing to the smaller angular elevation at which the camera then points, form a suitable background; if this course is not practicable, choose a time of day when the sun is in front of the building, but obscured by cloud; dark clouds behind the object itself are beneficial.

"Tele-photographs (and in fact all photographs) of architectural details should be taken in diffused light, in order to obtain good detail throughout the shadows. Strong sunlight is apt to yield photographs that are flat and wanting in gradation, both in shadows and high lights, with excessive contrast (technically termed soot and whitewash). Photographs taken in diffused light are easier to develop, and give the effect of roundness or modelling more truthfully, whilst contrast is easily obtained with a long range of gradations, in place of an abrupt change from white to black.

"On no account should direct sunlight shine into the front or positive lens; should the hood on the lens not be deep enough to prevent this, an umbrella or a hat may be used to screen it; as the angle of view of a tele-photo lens is samll, there is no great danger in so doing."

CHAPTER X.

DALLMEYER ON TELE-PHOTOGRAPHIC PORTRAITURE.

The special use of the tele-photographic lens in delineating groups and portrait studies in pleasing perspective are briefly touched upon by Messrs. Beck and the Editor of "The Photo Miniature"; and Mr. Marriage in his book devotes part of a chapter, with illustrations, to a consideration of the subject. It is, however, treated with the greatest fulness and authority by Mr. Dallmeyer, by whose kind permission I am enabled to make the following quotation from his book. Realising the importance of the matter, especially to photographers working under the disadvantage of having to use short focus lenses or short studios, Mr. Dallmeyer places portraiture first in the long and interesting chapter in which he describes some important practical applications of the tele-photographic lens:—

Rendering of Perspective by the Tele-photographic Lens.

It is probably a matter of common observation that the finest portraits are produced by photographers having the advantage of a long studio. Where the studio is sufficiently long, the photographer is always able to take up a standpoint from which a study of a head, head and shoulders, and so on to full length of the figure, is seen to the best advantage. In general, the distance must be increased as the amount and depth of subject which he intends to portray increases. In order to do himself and his subject justice, these distances should never be departed from, whatever the scale of the image is to be. The lens should be placed at the correct viewing distance, and the focal length of the lens chosen to give the scale required, determining the size of the final image. No one positive lens of ordinary construction and definite focal length can answer all purposes satisfactorily. If the focal length be great, suitable for a "life-size" head, for example, the lens would be quite unsuitable for taking a "cabinet" standing figure, because it would have to be removed so far from the subject that the image would apear flat. Conversely, if a lens of shorter focal length, suitable for the "cabinet" standing figure, were employed to take a "life-size" head, it would have to be brought so close to the sitter that the drawing of the head would be altogether unsatisfactory. The general tendency in ordinary photographic practice is to commit the latter error—viz., to aim at too large an image with a lens which is too short in focal length to allow an adequate distance to intervene between the subject and lens for good perspective rendering. The tele-photographic lens affords the great advantage of always enabling the larger sizes of portraits to be taken under favourable conditions for proper perspective rendering. Again, its perspective is always better than that given by an ordinary positive system of the same focal length—due to the greater distance that may intervene between subject and lens.

COMPARATIVE EXAMPLES.

Let us now illustrate some comparative examples of the employment of ordinary and tele-photographic constructions. The production of a "life-size" head: We know that to accomplish this with an ordinary lens the sitter must be at a distance equal to twice the focal length of the lens from it. Suppose we take a lens of 5 inches diameter and 40 inches focal length (intensity f-8); the distance of the sitter from the lens must be 80 inches, and the camera extension also 80 inches. A distance of 80 inches is none too far for good perspective rendering, and yet it is seldom that even this distance intervenes between lens and sitter for a "life-size" head, because the focal lengths of most large portrait combinations are less than half this distance, or 40 inches. Let us now form a tele-photographic lens by combining a rapid cabinet lens of 3½ inches diameter and 10 inches focal length with a negative lens of 4 inches focal length. If we place the combination at the same distance (80 inches) from the sitter, the positive element alone gives an image one-seventh the size of the original. In order that the final image may be of the same size as the original, we must magnify it seven times. To do so, the focussing screen must be placed at a distance E from the negative lens, where $E = f_1(M - 1) = 4\ (7 - 1) = 24$ inches, as compared with 80 inches above. On adjusting the separation between the lenses by means of the rack and pinion mount, the image will now be found to be of the same size as the original. To compare our present conditions for rapidity with those above, we must determine the focal length of the combination when thus employed. Substituting $E = 24$, $m = \frac{10}{4} = 2\frac{1}{2}$, $f_1 = 10$ and N (for equal size) $= 1$;

$$\text{Focal length} \qquad = \frac{mE + f_1}{\frac{m}{N} + 1}$$

$$= \frac{60 + 10}{2\frac{1}{2} + 1} = 20 \text{ inches only.}$$

and hence this combination will work at the same initial intensity as the former with an aperture of only 2½ inches.

The Question of Rapidity.

Observe that as the lens produces the image of equal size with the object, the position of the screen must be 20 inches distant from its focal point, or focus for parallel rays. In other words, the combination focussed for a very distant object would form an image at a distance of 24—20, or 4 inches from the negative lens. For parallel rays we see $F = m\,E + f_1 = 10 + 10 = 20$ inches, and our conclusion is confirmed. From this result we can proceed to emphasise the valuable and important fact that a greater distance must intervene between a tele-photographic lens and the subject than is required for an ordinary lens of the same focal length. With the former we have found 80 inches is required, while with the latter it must be twice 20, or 40 inches. These results also exemplify in a striking manner the fallacy of the usual tenet that the correct viewing distance of the photograph should be determined by the focal length of the lens with which it was taken. The result by the 20-inch tele-photographic lens and the 40-inch lens of ordinary construction should, of course, be viewed from the same standpoint when the result is "life-size"; and, again, we see that if both lenses have the same focal length the result produced by a lens of ordinary construction should be viewed at a distance of 40 inches only as against 80 inches by the tele-photographic system. The latter is the more likely distance from which a "life-size" head would be viewed, and the result by the tele-photographic lens will appear in better drawing, and be a more truthful representation. Although there is a considerable gain in using the tele-photographic lens, both as regards improved perspective and greater depth of focus, as compared with the lens of ordinary construction, there is a loss in rapidity when two lenses of the same focal length are compared. The comparative rapidities are now influenced by the "law of inverse squares" and their exposures are proportioned to the squares of their respective distances from the subject. We have seen, however, that a tele-photographic lens of considerably shorter focal length than an ordinary lens can produce the same size of image at an equal distance, and hence the diameter of the positive element in the tele-photographic system may be smaller and yet give the same rapidity; this will be found both an advantage and an economy. Reverting to the case of a "life-size" representation of a head, it is obvious that the distance of 80 inches is not by any means binding in the case of one and the same tele-photographic combination. Both theoretically and practically this lens may be placed at any greater distance we choose from the sitter. If a greater distance be chosen the scale of the image produced by its positive element becomes smaller, and therefore requires greater magnification by its negative element in order to yield the same size of image finally.

Practical Hints on Tele-photographic Portraiture.

It is probable that a distance of 10 or 12 feet will be chosen for the representation of a "life-size" head. At 10 feet, employing a tele-photographic lens composed of a cabinet lens of, say, 12 inches focal length and 4 inches aperture as positive element, and a negative lens of 6 inches focal length as negative element (to vary the numerical examples), the primary image will be one-ninth of the original, and we must magnify it nine times for equal size. This requires a camera extension of $6(9—1)=48$ inches, which shows that the lens has a focal length of 36 inches, and therefore an initial intensity of f9. If we wish to produce the image in the scale of half natural size, it is evident that all we have to do is to magnify the image $4\frac{1}{2}$ times. In this case we must take the camera extension $6\ (4\frac{1}{2}-1)$ or 21 inches. The focal length of the system is now 26 inches, and the intensity

$$\frac{4}{26}=\frac{F}{6\cdot5}$$

It is hardly possible to give any hard and fast rules for the method of procedure in the various requirements of large portraiture, but it may safely be said that if a certain carte de visite or cabinet lens produces the size of image for which it was constructed at a given distance from the sitter, in really satisfactory perspective, these images may be taken as a basis of subsequent magnification by the negative elements with which they are combined to form tele-photographic systems. The magnification of the primary image produced by the positive element can be accomplished in either of two ways: (1) By using a negative element of very short focal length in comparison to the positive element, or, in other words, making $\frac{f_1}{f_2}$, or *m*, great, and using only a very small camera extension; or (2) by using a negative lens of longer focal length, or making *m* small, and obtaining the same magnification by the necesarily greater camera extension. The latter method is far preferable in portraiture, and, in fact, in almost all cases, as the conditions favour greater covering power, more even illumination, and freedom from distortion of the lines near the margin. For portraiture the focal length of the positive element should not be more than 2 to $2\frac{1}{2}$ times as great as that of the negative lens, or *m* should not exceed $2\frac{1}{2}$.

Mr. Dallmeyer illustrates the above-quoted extract by five reproductions from studio portrait negatives, which form a feature of his book that should be found instructive by the principal sinners in the production of distorted portraiture, professional photographers. These plates show the advantage of the tele-photographic lens in avoiding distortion, and of rendering, to quote Mr. Dallmeyer, "the relative planes of the picture" in "their proper values in respect of drawing."

CHAPTER XI.

CIRCLE OF ILLUMINATION; ANGLE OF VIEW; EQUALITY OF ILLUMINATION; RELATION OF APERTURE TO MAGNIFICATION.

Messrs. Beck's little pamphlet, "Practical Notes on Tele-photography," deals with the rudiments of the subject in concise form throughout; and, in especial, is singularly explicit and helpful when touching on some of the puzzling phenomena which confront the tele-photographer who, without previous reflection, finds that when for the first time he points his system at a more or less distant object the image on the ground glass screen is not controlled in the same manner as with an ordinary lens. The following points, which are so tersely expressed, if committed to memory, or carefully studied, by the novice before venturing on practical work will save him much needless confusion:—

The diameter of the size of the field varies directly with the magnification (or length of focus) of the tele-photo system, although it is slightly decreased by the use of a small stop. It has been thought necessary to mention this fact because when using a tele-photo lens with only a low magnification, the ground glass will have a circle of light on it representing the view, while the corners will be black. Such an appearance might lead those unaccustomed to the use of the lens to suppose that their manipulation was defective, but when a small or low magnification only is required, as is occasionally the case, it is impossible to cover the whole plate. A slight adjustment to the tele-photo lens increasing the magnification will rapidly enlarge the diameter of the field of view, spreading the image over the whole surface. An example may make the point clear. A quarter-plate tele-photo lens when magnifying three times (i.e., when an object is depicted three times as large as by the positive alone) illuminates sharply a circle of view 2½ inches in diameter. This would not fill the whole of a quarter-plate, but when the magnifying power is increased to ten times, the circle of view illuminated becomes 9½ inches in diameter, which would not only cover a quarter-plate, but even a half-plate. The following table gives the diameters of the circle of illumination necessary to cover plates of different sizes.

Plate in use.	Circle of View required in inches.
4¼ × 3¼	$5\frac{4}{10}$
5 × 4	$6\frac{4}{10}$
6½ × 4¾	8
7 × 5	$8\frac{6}{10}$
8½ × 6½	$10\frac{7}{10}$
10 × 8	12¾
12 × 10	15½

The angle of view included in the circle of the field of view does not vary with the magnification. If a certain amount of the landscape is included within the complete circle of view, altering the magnifying power will increase or decrease the size of the picture and the circle of illumination with it, but will not alter the amount of the landscape in the whole field. Equality of illumination is increased by stopping down the positive. By equality of illumination is meant the power of a lens to throw as much light to the edge of the field of view as to the centre. If a lens illuminates the edges of the field of view as brilliantly as the centre, then the equality of illumination is perfect; but if the light gradually fades away into total blackness from near the centre to the edge, the reverse is the case. The field of view of a tele-photo lens somewhat shades off in this way near the extreme margin of the field. This is due to the distance of the lenses of the system from one another. It is, however, not very appreciable if the positive lens is one of the modern orthostigmatic or anastigmatic type. To find the effective aperture or rapidity of a tele-photo lens in terms of the focus (f):—Multiply the aperture of the positive by the magnification in use. Thus, if the diaphragm of the positive be set at an aperture of f-8, and a magnification of 4 be in use, the resultant aperture of the whole system in terms of the focus will be f-32, and if an exposure of 4 seconds was correct with the positive alone, 64 seconds must be given for the tele-photo lens. To find the aperture, multiply the aperture of the positive by the magnification. To find the requisite exposure, multiply the exposure required by the positive alone by the square of the magnification. The following table will give at a glance the largest magnification that should theoretically be used with different apertures.

Aperture.	Maximum Magnifying Power.	Aperture.	Maximum Magnifying Power.
f-4	18	*f*-16	4½
f-6	12	*f*-22	3¼
f-8	9	*f*-32	2¼
f-11	6½		

This further emphasises the necessity of having a good rapid positive. A positive having nominally a very large aperture, but lacking equality of illumination and first-class corrections, will have to be stopped down before definition is obtained, and in this case it is no better than a slower lens, which does not need stopping down.

CHAPTER XII.

STEINHEIL'S APPLICATION OF THE GALILEAN TELESCOPE TO TELE-PHOTOGRAPHY.

In the first chapter I referred to the application by the late Dr. Adolph Steinheil of the Galilean telescope for tele-photographic purposes. His article on the subject appeared in the "Photographische Correspondenz" in 1892, and is here presented in a condensed form. After pointing out that the Galilean telescope is formed with an objective of positive and an eye-piece of negative focus, and the inverted image projected upon the retina appears to be upright, and that in the astronomical telescope a second inverted real image is formed in the tube at the focus of the objective, in addition to the image formed upon the retina, which, although upright, is seen inverted through the use of a micrometer eye-piece, Dr. Steinheil continues:—In both cases two lenses placed at a distance from each other will suffice, the second lens being of the nature of an eye-piece. In fig. 1 the path of the rays is represented in the case of the construction being a Galilean telescope, and in fig. 2 in the case of it being an astronomical telescope.

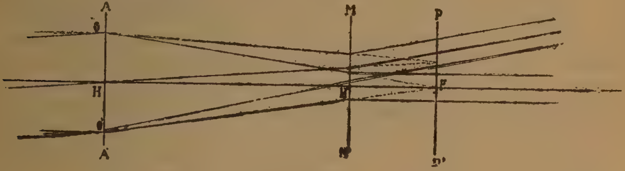

Fig. 1.

In the case of fig. 1, the Galilean telescope, the object-glass and the eye-piece may be calculated together, that is to say, the errors may be eliminated at once for the entire telescope, so that object-glass and eye-piece may have opposite errors. But in the construction represented by fig. 2, the astronomical telescope with micrometer eye-piece, the object-glass and the eye-piece must form correct images independently of each other, if the image of the cross wires has to be distinct and undistorted, as mentioned above.

In fig. 1 let AA^1 be the principal plane of the objective, H its principal point, F the focal point, and HF the true focus. Let OO^1 be the effective aperture, that is to say the points of incidence of the marginal rays of the axial pencil. The relative aperture, or quotient aperture and focus, will be $\frac{OO^1}{HF}$. The angle OFO^1 is termed the angular aperture of the objective. Let MM^1 be the principal plane of the eye-piece, H^1 its principal point, HH^1 the distance between the principal points of object-glass and eye-piece, then, if H^1F be the focus of the eye-piece, the rays forming the axial pencil of light, proceeding from the object-glass, will be transmitted parallel by the eye-piece. At this place the eye-piece is in its nearest position to the object-glass, and this is the maximum limit of amplification. The image is infinitely distant and infinitely large. If the eye-piece be brought still nearer to the object-glass and receive the pencil of light too soon, no image will be formed, because the rays will diverge after passing through the lens. If the eye-piece be removed to a greater distance from the object-glass, the aerial image will be brought nearer. This will gradually diminish in size until the eye-piece is so far removed, and so little included, that the image is situate just outside the last glass surface. The image is then scarcely larger than that formed by the object-glass direct. This may be termed the minimum limit of amplification.

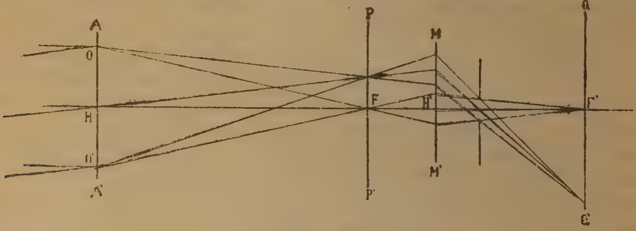

FIG. 2.

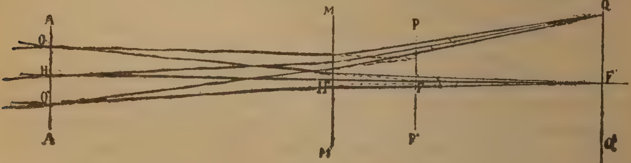

FIG. 3.

Dr. Steinheil then proceeds to examine the relation subsisting between the foci of the object-glass and eye-piece; the relative brightness of image formed by the object-glass compared with that of the entire telescope, the possibilities of enlargement and size of field, and finally the total length of the telescope as measured from the first surface of the object-glass to the enlarged image.

The intensity of the objective, as is well known, may be expressed in two ways, either by the relative or the angular aperture (angle OFO^1 in fig. 3). If the intensity of the lens be f-6.35, it will be equal to 9^0. (This is actually the case with a lens of 20 mm. aperture and 127 mm. focus.) By the same number of times we diminish the angle of aperture, we likewise increase the size of the image obtained by the system, when compared with that formed by the object-glass alone, but the equivalent focus of the telescope thus formed also exceeds, by the same number of times, that of the object-glass.

Let us assume, according to fig. 1, that the aperture OO^1 of the object-glass be 20 mm., and the true focus, HF, 127 mm. The relative aperture will then be f-6.35, and the angular aperture 9^0. If an eye-piece be required giving threefold enlargement, it must reduce the refraction of the object-glass by two-thirds. The angular aperture of the entire system will then be 3^0, the equivalent focus of the telescope $3\times127=381$ mm., and its intensity will be nine times less[1] than that of the object-glass. In other words, the period of exposure must be nine times greater than for a photograph taken with the object-glass alone.[2]

It has now to be determined where the eye-piece shall be placed, and what shall be its negative focus. The eye-piece may be placed at any point we deem desirable. The nearer it is to the object-glass, the greater must be the length of the telescope. Its size must also be greater, and it will have a larger field. Let H^1 be the principal point of the ocular, and the distance $HH^1=84\frac{2}{3}$ mm. The eye-piece embraces the distance, $H^1F = HF - H^1H = 127 - 84\frac{2}{3} = 42\frac{1}{3}$ mm. This is one-third of the focus. The eye-piece placed at H^1, in order to reduce the angular aperture to 3^0, must consequently refract -6^0. It should therefore receive a negative equivalent focus of $\frac{3}{2}H^1F=63\frac{1}{2}$ mm., and refract the rays to F^1. This lengthens H^1F to H^1F^1, that is to say, increases the distance three times. The increase in the equivalent focus of the telescope, compared with that of the object-glass alone, is proportional to the increase of the distance H^1F compared with H^1F^1. As the latter has been multiplied three times, the equivalent focus of the telescope must also be three times greater than that of the object-glass, and consequently equal to 381 mm. We thus find that the combination of an object-glass of 127 mm. focus with an eye-piece of $-63\frac{1}{2}$ mm. equivalent focus, at a distance from each other of $HH^1=84\frac{2}{3}$ mm., enlarges the image three times, and the telescope has a length of $HH^1+3\times H^1F=84\frac{2}{3}+127=211\frac{2}{3}$ mm.

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[1] It is a well-known fact that the square of the times of enlargement represents the falling off in the brightness of the image and the number of times the exposure must be increased.

[2] The loss of light occasioned by the surfaces of the eye-piece has not been taken into account.

Any number of eye-pieces may be calculated for the same object-glass, all giving the same degree of enlargement. The only difference will be in the length of the telescope and the extent of the field. Directly the angular aperture of the object-glass is reduced from 9^0 to 3^0, the size of the image is the same. The greater the distance between object-glass and eye-piece, the shorter will be the telescope, but the conditions are less favourable for a large field. The further the eye-piece is placed from the object-glass, the shorter must its equivalent focus be. The aperture of the eye-piece must then be smaller, and likewise the size of the field, given the same intensity of illumination. A lens, like that which we have selected as an example, may also be used for enlarging to any size, according to the position in which it is placed. The size of the eye-piece is the only obstacle. It may be too small for the position selected and not admit the whole of the cone of rays transmitted by the object-glass. If the eye-piece be brought closer to the object-glass, the former will work at a larger aperture (cutting off light if too small), and the enlargement and the total length will be increased. If the intensity must be greater, or, in other words, the exposure shorter, the length of the entire telescope must be increased, provided the effective aperture and the degree of magnification remain the same.

CHAPTER XIII.

DEGREES OF ENLARGEMENT OBTAINABLE WITH THE PHOTO-TELESCOPE.

As recorded by Dr. Steinheil, the first photographic telescope constructed according to the Galilean type for terrestrial purposes, was supplied by him in February, 1890, to the Hydrographic Department of the German Admiralty, and used for coast photography. He continues: We have already mentioned that it is impossible to make this type of photographic telescope with cross wires, which can be photographed simultaneously with the picture. This is frequently necessary, as for instance in astronomy, and such was actually the case when the first photographic telescope was ordered from me. A different type of construction must then be adopted. The object-glass must give a correct image, although very small. This aerial image is enlarged with a simple magnifier, or a micrometer eye-piece (compound magnifier). We have already mentioned, that the astronomical telescope with micrometer eye-piece fulfils these conditions. The magnification in this arrangement is determined by the position of the eye-piece, whilst the size of the aerial image depends upon the focus of the objective.

In fig. 2, if OO^1 be the principal plane of the objective, H its principal point, and F its focal point, the true focus will be HF, and upon it depends the size of the image of the object. The intensity of image again depends upon the relative or angular aperture of the objective. The cross wires are placed at the focal point of the objective.

If we take the sun or moon as an example—an object of about 34 minutes diameter; the size of the direct aerial image will then be HF tg 34′, which is about one-hundredth of the focus.

The size and equivalent focus of the eye-piece are optional. Any degree of amplification of the aerial image may be obtained with an eye-piece of whatever focus. But the length of focus and effective aperture of the eye-piece determine the length of the enlarging apparatus and the diameter of that portion of the image, which is magnified.

For instance, if the eye-piece has an equivalent focus of 3 cm., and its principal point be 6 cm. from the image formed by the object-glass, then an image of the same size will be formed 6 cm. beyond the principal point of the eye-piece. The distance between the image formed by the object-glass and that formed by the eye-piece will be 12 cm. and the magnification 1, or natural size.

Any degree of magnification may be obtained with such an eye-piece of 3 cm. focus. It will depend upon the situation of its principal point and where this is placed between the two positions, 3 and 6 cm. distant from the aerial image (one or two foci of the eye-piece).

If p be the equivalent focus of the eye-piece, a the distance between the image, formed by the objective, and the principal point of the eye-piece, α the distance between the principal point of the eye-piece and the image it forms, the well-known relation recurs

$$\frac{1}{p} = \frac{1}{a} + \frac{1}{\alpha}$$

The magnification may be expressed by the quotients $\frac{a}{\alpha}$ and the intensity decreases with the square of these quotients, if compared with the intensity of the object-glass.

The size of the aerial image to be magnified may increase, as we have already said, with the available aperture of the eye-piece. On the other hand the diameter of the aerial image, which can be magnified, grows in proportion to the equivalent focus of the eye-piece, given the same construction. By means of the table given herewith, the length of the enlarging apparatus may be calculated with ease for any degree of enlargement. The times of enlargement will be found in column I. Take the figures upon the same horizontal line in columns II. and III.), add them and multiply their sum by the equivalent focus of the eye-piece.

I	II	III	I	II	III
1	2·00	2·00	6·5	1·15	7·50
1·1	1 91	2·10	7·0	1·14	8·00
1·2	1·83	2·20	7·5	1·13	8·50
1·3	1·77	2·30	8·0	1·12	9·00
1·4	1·72	2·40	8·5	1·12	9·50
1.5	1 67	2·50	9·0	1·11	10·00
1·6	1·62	2·60	9·5	1·10	10·50
1·7	1·59	2·70	10·0	1·10	11·00
1·8	1·56	2·80	11·0	1·09	12·00
1·9	1·53	2·90	12·0	1·08	13·00
2 0	1·50	3·00	13·0	1·08	14 00
2·1	1·48	3 10	14·0	1 07	15·00
2·2	1·45	3·20	15·0	1 07	16·00
2·3	1·43	3·30	16·0	1 06	17·00
2.4	1·42	3.40	18·0	1·06	19·00
2·5	1·40	3·50	20 0	1·05	21 00
2·6	1·38	3·60	22·0	1·04	23·00
2·7	1·37	3·70	24·0	1·04	25·00
2·8	1.36	3·80	26·0	1 04	27·00
2·9	1·34	3·90	28 0	1·04	29·00
3·0	1·33	4 00	30 0	1·03	31·00
3·2	1·31	4·20	35 0	1·03	36·00
3·4	1·29	4·40	40 0	1·02	41·00
3·6	1·28	4·60	45·0	1·02	46·00
3·8	1·26	4·80	50·0	1·02	51 00
4·0	1·25	5·00	60·0	1·02	61·00
4·5	1·22	5·50	70·0	1·01	71·00
5·0	1·20	6·00	80·0	1·01	81·00
5·5	1·18	6·50	90·0	1·01	91·00
6·0	1·17	7.00	100·0	1·01	101·00

For instance, if it be required to enlarge six times, take figures 1.17 from column II. and 7.00 from column III. Their total is 8.17. If the eye-piece be of 3 cm. focus, the length of the enlarging apparatus must be 24.5 cm. By adding the focal length of the objective, say 24 cm., we obtain the focal length of the telescope, 48.5 cm., whereas the equivalent focus would be 144 cm. According to the well-known rule, this is obtained by multiplying the focus by the magnification.

To compare photographic telescopes with regard to their efficiency, it must be remembered, that the amount of light forming the image is determined by the aperture of the object glass and that the size of the image depends upon the equivalent focus, and the field made use of. The effective aperture can easily be measured. It is likewise easy to determine approximately the equivalent focus of the telescope and the angle of field used, by photographing the moon. The equivalent focus of the telescope is very nearly 100 times the diameter of the image of the moon. The diameter of the moon is about equal to $\frac{1}{2}$ a degree of visual field. By means of a photograph the equivalent focus and the angle of field may at once be reckoned. For instance, if the diameter of the image of the moon be 11 mm., and the diameter of the entire picture 70 mm., then the equivalent focus is 110 cm., and the field of view rather more than 3^0.

CHAPTER XIV.

A FIXED FOCUS TELE-PHOTOGRAPHIC SYSTEM.

UNDER the heading of "Reduced Telescopes," Messrs. C. A. Steinheil Söhne, of Munich, in their catalogue of astronomical and physical instruments, draw attention to the fact that telescopes of long focus may be made of relatively short dimensions, either by magnifying the aerial image formed by an objective of moderately long focus, by means of a lens system having a positive focus (positive magnifying system), or by intercepting, before the primary image is formed, the pencil of rays emerging from the principal objective by means of a lens system of negative focus (negative magnifying system), whereby the principal point of the whole system is brought in front of the principal objective. They also point out that in either case the image thus formed corresponds to that of a telescope having a relatively long focus, and that these reduced telescopes are made both for ocular observation and for photographic purposes. One such instrument of the latter kind may be

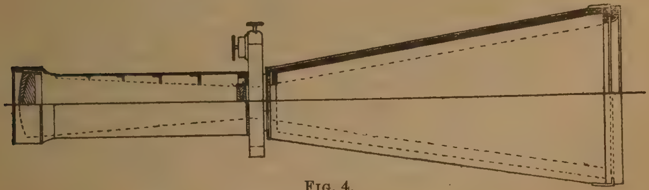


FIG. 4.

referred to here. The illustration shows a section of the system, a shutter indicated by the milled-head screw working immediately behind the triple negative element. The camera portion is indicated by the thick line, and double dark slides are used. In fig. 5 a suggestion is given for the mounting of the instrument. By the courtesy of Messrs. Steinheil I have had an opportunity of examining the system marked No. 1 on the appended list. I have termed it a "fixed focus system" in contradiction to the ordinary tele-photographic lens, which admits of variation of focus :—

Number.	Aperture of Objective.		Focus.		Diameter of largest obtainable solar image.		Largest equivalent focus.		Length of the entire telescope.	
	mm.	in.	cm.	in.	mm.	in.	cm.	in.	cm.	in.
1	61	$2\frac{7}{16}$	35	$13\frac{3}{4}$	12.	$\frac{1}{2}$	ab. 120	$47\frac{1}{4}$	65	$25\frac{5}{8}$
2	68	$2\frac{11}{16}$	81	$31\frac{7}{8}$	90	$3\frac{9}{16}$	,, 900	$351\frac{3}{8}$	114	$44\frac{7}{8}$
3	81	$3\frac{3}{16}$	98	$38\frac{1}{8}$	108	$4\frac{1}{4}$	,, 1200	$433\frac{1}{8}$	130	$51\frac{3}{16}$
4	103	$4\frac{1}{4}$	162	$63\frac{3}{16}$	216	$8\frac{1}{2}$	,, 2200	$866\frac{1}{4}$	230	$90\frac{9}{16}$

Disregarding the references to the solar image, this system of Messrs. Steinheil should be found useful by tele-photographers who seek to take small instantaneous views of objects situated at distances of from six hundred to a thousand yards. In fact, it is due to the inquiries of a photographic friend that I here give prominence to this system of telescopic photography. His aim is not so much to secure greatly enlarged representations of distant objects, but rather to be able to place at the eye-piece end of his telescope a small camera in which he may take, let us say, lantern-size snapshots of a passing steamer, birds on the wing, groups of persons, animals, coast views, and the like. But obviously these "reduced telescopes" have other photographic uses, which are indicated by Dr. Steinheil in the two previous chapters.

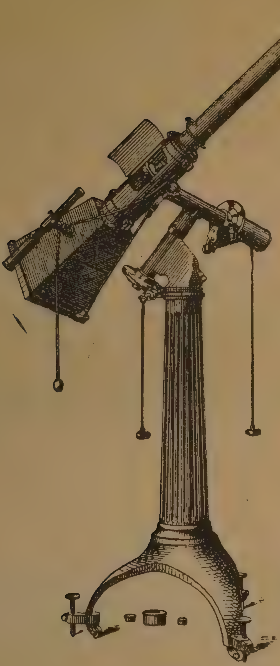


FIG. 5.

CHAPTER XV.

TABULAR DATA

MOST, if not all, the makers publish tabular data on camera extension, foci, image diameters, magnifications, etc., in relation to the use of tele-photographic systems. The following one by Messrs. Steinheil is a typical one, but with the added advantage of being in metrical as well as English measurements ;—

STEINHEIL'S TABLE OF CAMERA EXTENSIONS, EQUIVALENT FOCI AND DIAMETERS OF IMAGES CORRESPONDING TO A GIVEN MAGNIFICATION OF THE TELE-PHOTOGRAPHIC OBJECTIVE.

MAGNIFICATION			3						5						8						10					
Tele-photographic Objective: Antiplanetic Group Lens Aperture		Negative Lens	Camera Extension		Equivalent Focus		Diameter of Image		Camera Extension		Equivalent Focus		Diameter of Image		Camera Extension		Equivalent Focus		Diameter of Image		Camera Extension		Equivalent Focus		Diameter of Image	
mm	in.	No.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.	cm.	in.
21	13/16	1	9·5	3¾	37	14⅝	6	2⅜	18	7⅛	62	24½	11	4⅜	29	11½	100	39⅜	18	7⅛	38	15	124	48¼	24	9½
25	1	2	12	4¾	43	17	7	2¾	21	8¼	72	28⅜	13	5⅛	33	13	115	45¼	22	8¾	42	16½	144	56,	27	10⅝
29	1⅛	3	15	6	49	19¼	9	3½	25	9¾	82	32¼	17	6¼	39	15⅜	131	51¾	28	11	50	19¾	164	64½	35	13¾
33	1 5/16	4	18	7⅛	55	21¾	11	4¼	31	12¼	92	36¼	21	8¼	47	18½	147	57⅞	33	13	62	24½	184	72½	43	17
38	1½	5	22	8⅝	63	24¾	12·5	4¾	36	14¼	105	41⅜	23	9 1/16	55	21¼	168	66¼	40	15¾	70	27½	210	82¾	47	18½
43	1¾	6	26	10¼	72	28⅜	14	5½	42	16½	120	47¼	25	9¾	64	25¼	192	75⅝	45	17¼	85	33½	240	94½	50	19¾
48	1⅞	7	30	11⅞	82·5	32½	15	6	46	18⅛	137	54	27	10⅝	73	28¾	220	86¾	55	21¾	95	37½	275	108⅜	60	23⅝
64	2½	8	38	15	108	42½	24	9½	63	24¾	180	70	42	16½	108	42½	288	113½	70	27½	130	51¼	360	142	90	35½

The above approximate values apply to the photography of very distant objects.

The values of the equivalent focus of the tele-photographic objective indicate, at the same time, the camera extension required by an ordinary photographic lens reproducing the objects in the same dimensional scale as the tele-photographic objective. The diameter of the image specified in the Table is that of the illuminated circle which is sharply covered by the tele-photographic objective working at the given camera extension.

CHAPTER XVI.

APPARATUS DATA.

Tele-photo attachments for hand-camera work are supplied by Messrs. J. H. Dallmeyer, Ltd. (the "Adon"), and Messrs. A. E. Staley and Co., 35, Aldermanbury, E.C. (the Bausch and Lomb). Both of these were briefly noticed at pp. 951-953 of last year's Almanac.

Besides Messrs. Dallmeyer, Beck, and Steinheil, tele-photographic systems for ordinary work are also supplied by Messrs. Zeiss, Messrs. Ross, and Messrs. Bausch and Lomb.

Messrs. Voigtländer have two series of tele-photographic systems:—(1) medium rapidity, a positive system working at f-8 in combination with a triple cemented negative; (2) a portrait positive working at f-3 in combination with a negative system. The latter series should be found useful for tele-photographic studio portraiture.

Types of Lenses.

Messrs. Dallmeyer's Notes on the Powers of Negative Elements.

I. High-power.—These lenses are most suitable where great magnification is required, but for general utility are perhaps not so well adapted to the average worker as the moderate-power lenses. They give equivalent foci of about five times the back focus, or, in other words, an amplification of 5 diameters as compared with the size of image given by the positive lens alone with the same amount of back extension, the amplification, as in every tele-photographic lens, increasing with longer extensions of camera.

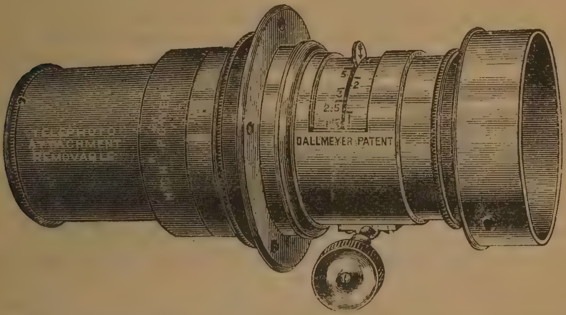


Fig. 6.—Dallmeyer Portrait Lens with high power negative attachment.

II. Moderate-power.—Give equivalent foci = about twice the actual camera extension employed, or three times the distance between negative and focussing screen. They are sufficiently rapid for all ordinary instantaneous work, and have the advantage of including a greater angle than system I., viz., about 17—21^0.

I. and II. Combined.—The combinations of high and moderate-power form, perhaps, the most valuable instruments for tele-photography, enabling the operator to obtain either very high amplification for mountain scenery and similar subjects, or to work instantaneously with the weaker negative element.

III. Moderate-power.—These (R.R.) combinations give similar results to system II., but the angle included is a rather smaller one, about 12—15^0, and they are not so rapid. The portrait lens combinations are—given an equal aperture of the front lens—also more compact and portable, and cover a given size of plate with a smaller back focus. The only drawback of system II. is that it shows a slight marginal distortion when used over the full limits of field that it will cover. The question of portability is more particularly noticeable in the larger sized negative elements, the 10-in. and 12-in. attachments especially not being recommended where system II. can be employed, unless bulk and compactness are quite a matter of indifference.

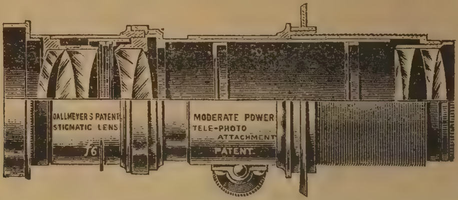


Fig. 7.—Stigmatic Lens, *f*·6, with moderate power tele-photo attachment.

The Steinheil Antiplanetic Tele-photographic System.

The antiplanetic group and rapid lenses, and the negative lenses constructed for them, are provided with similar screws for attachment to the camera front. The antiplanetic lens may therefore be screwed to the same flange, both with and without the negative lens. The latter is attached to the flange of the camera front by means of the screw, C, and the same screw to unite the positive and negative lens at G. After adjusting the camera extension in accordance with the table on page 732, the objective should be focussed with the utmost accuracy at full aperture by means of the rack and pinion, T, for it must be borne in mind that the sharpness of the image is much more liable to be disturbed in this case than would happen with ordinary photographic lenses, partly as a consequence of the increased magnification, and partly in consequence of external circumstances, such as the tremor of the unequally heated and disturbed atmosphere and vibration of the camera owing to the increased length and weight of the objective. The stopping of the aperture is effected in the objective only.

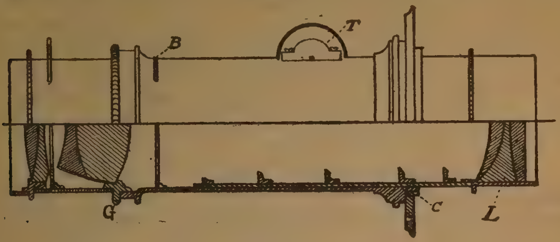


FIG. 8.

THE BECK-STEINHEIL TELE-PHOTO SYSTEM.

The Beck-Steinheil tele-photo lens consists of an ordinary photographic lens, A, screwed into the tele-photo attachment, B. The latter consists of a negative lens, C, mounted at the end of a brass tube, which screws into the flange, D. This flange is fixed in the ordinary way to the camera front, and is of such a size that it will allow of the use of the positive lens, A, alone, or the complete system, without the addition of an adapter. By rotating the milled head, F, the distance between the positive, A, and the negative, B, can be varied at will. If the distance be varied in this way, the focus of the system will be altered, as has been pointed out, and therefore the magnification. The tube, E,

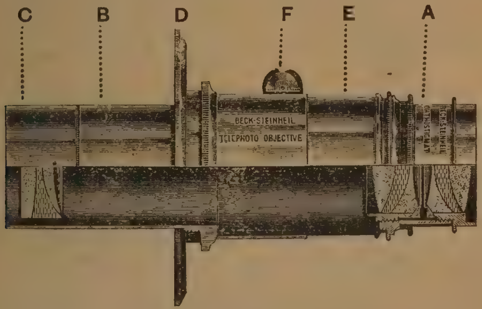


FIG. 9.

is engraved with a scale 3, 5, 8, 10, 15. These numerals represent the magnifying power, or the number of times the image produced by the tele-photo lens is larger than that which would be produced by the positive alone. The milled head, F, can be used to finally adjust the focus if the exact magnification is not of importance. The combination illustrated is a Beck-Steinheil orthostigmat Series I., f-6.3, and a Beck-Steinheil triple cemented negative lens or attachment mounted in a brass tube, with a rack and pinion focussing motion, and engraved with the magnifications.

THE DALLMEYER TELE-PHOTOGRAPHIC CAMERA.

THIS instrument resembles the American type of folding camera, of which the next illustration gives some idea. I quote the official description:—"For use as a hand camera, or with lenses of ordinary focal length, the front baseboard is lowered, and the bellows pulled out and clamped. Fine focussing is effected by means of a short rack and pinion; a scale for snapshot work is also provided. The front carrying the lens and shutter rises, falls, and swings, thus obviating the necessity for a swing back. There is a removable door in the rear baseboard to allow of inspection of the image upon the focussing screen without having to lower the baseboard itself. The focussing screen is held in position by strong springs, and the slide is readily inserted between the screen and camera frame, the end of the slide being made V-shaped for this purpose. The back reverses for horizontal and vertical pictures, and the openings through which the slide is inserted and the shutter withdrawn are provided with metal doors,

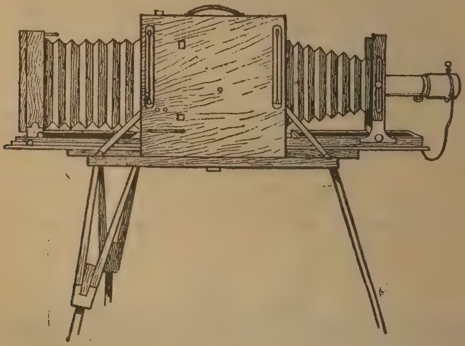


FIG. 10.

Camera and Stand used by Mr. Theo Kytka for outdoor tele-photography.
["Camera Craft," November 1901.]

which effectively protect the slide when the shutter is drawn. When the camera is required for tele-photo or other long focus work, the rear baseboard having been lowered or secured by means of a sliding frame, the back portion of the body is unclamped and fastened at any desired position on the baseboard, an extension of over three times the longest side of the plate being easily obtained."

BECK'S APPARATUS AND SETS FOR TELE-PHOTOGRAPHY.

Cameras of the square form, and having a double extension, are recommended by Messrs. Beck. They have parallel bellows, are made of Spanish mahogany, and have check screws to all milled heads, reversing frame, spring catch to holder, vertical and horizontal sliding fronts, with brass slots, patent plate screen, and the backs are fitted with special spring fastenings.

The No. 8 G Folding Frena is also recommended for quarter-plate tele-photo hand cameras. This instrument, although it shuts up into space $5\frac{5}{8} \times 4\frac{1}{4} \times 1\frac{5}{8}$, has an extension of 11 inches, and is so arranged that the tele-photo attachment screws in behind the lens, and the shutter, therefore, can still be used.

BECK'S COMPLETE SETS FOR TELE-PHOTOGRAPHY.

Messrs. Beck list the following :—

Set No. I.—For all work of any kind.—Square model double extension camera, with 3 double dark slides, tripod and head for tilting, Beck-Steinheil lens, tele-photo attachment, standard and low power interchangeable, with 2 scales fully engraved, mounted in magnalium, with focal plane shutter, giving exposures from $\frac{1}{8}$ to $\frac{1}{800}$ second, in leather case, with iris shutter, mounted on the lens in aluminium, exposures 3 seconds to $\frac{1}{150}$.

Set II.—Sanderson model camera, with all adjustments, and Beck-Steinheil lens and standard power attachment with iris shutter on the positive in brass, with tripod and 3 double dark slides, in canvas case, exposures from 1 second to $\frac{1}{100}$.

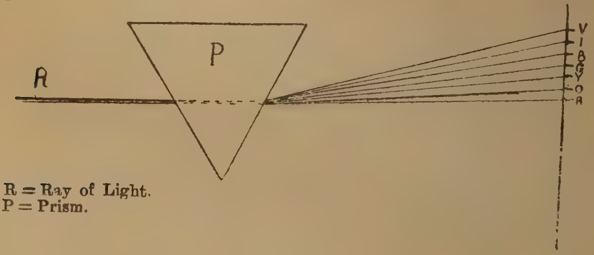
Set No. III.—Sanderson model camera, with all adjustments and autograph lens and standard power attachment, with roller blind shutter, tripod and double darks, in soft canvas case.

It will be seen by these catalogue extracts that the leading makers have interested themselves in the provision of special apparatus for tele-photographic work of all kinds. Good work may be done with most tele-photo systems, but, to obtain the best results, the negative lens should be calculated for the type to which the positive lens belongs. This is the practice in the systems recommended by our best opticians. A glance through the advertisement pages of this Annual will no doubt show that interest in this branch of work has also spread in other directions.

THE McDONOUGH-JOLY PROCESS OF COLOUR PHOTOGRAPHY POPULARLY EXPLAINED.

By A. V. Kenah.

In this article I shall endeavour to explain a method whereby anybody who is able to take an ordinary photograph in monochrome can, with practically no more trouble whatsoever, take photographs of places, people—in fact, anything—in all the colours of the original object. Now, inasmuch as it adds considerably to the pleasure and chances of success if we understand the why and wherefore of our actions, there is no reason that the art of taking photographs, either in monochrome or in colours, should be an exception; I, therefore, intend to explain the theory of this process. To start with, it is known in America as the "McDonough process of Colour Photography," and in England the name of Dr. Joly, of Dublin, is also coupled with that of the American, as they were both workers on the same track, and their descriptions are simultaneously published. Now, the reason we are able to see objects is that luminous rays proceeding from the sun fall on them, and are reflected from the object and received by the eye, and carried from the eye to the brain, where the impression of the object is formed by the brain. This, however, does not explain the phenomena of colour, as the direct rays of the sun appear to our eyes as being white. We must proceed to analyse, therefore, these rays of white light. To do this we place in the path of the rays a prism of glass, which consists of a piece of glass, one side of which is inclined to the other. The effect produced on the ray of white light is to scatter it into a band of colours called the spectrum, as in fig. 1.



R = Ray of Light.
P = Prism.

Fig. 1.

These colours are in the following order: red, orange, yellow, green, blue, indigo, and violet, and, furthermore, it will be seen that the red is deviated very much less than the violet. To cause this spectrum to return to white light again we simply place another prism in its path, of course inverting the prism, and we get white light again. From this experiment we learn that white light is really of a very composite nature.

Now, suppose we take a piece of red glass and hold it up to the sun, we no longer see the sun white, but, instead, it is red. Why is this? Well, we have shown that white light consists of several colours, among them being red; therefore the explanation is that we have, by placing the red glass in the path of the rays of white light, prevented all the rays of which the light consists getting through and producing their impressions on our brain except the red rays. This principle will apply equally as well to any other colour. We, therefore, understand that the reason we see an object in any particular colour is because there is some material in that object which is capable of cutting off, or absorbing, all the other constituents of white light except the dominant hue of the object. If we proceed further, it can be shown that every colour which we know of is capable of being formed by a combination of three colours, viz., red, green, and violet. Thus pink is a mixture in certain proportions of green and red and yellow of red and green, and so on for any colour other than one of these three primary ones. We will return to this most important observation later on. It must, of course, be clearly understood that all these remarks remain as concrete facts on account of their relationship with the human eye. Let us, therefore, diverge for a short space, and try to understand what part the eye plays in our sphere of action. The eye, for the sake of our inquiry, we will take as consisting of two parts, viz., the lens and the retina. The lens of the eye acts in the same way as the lens of our camera, viz., it collects the rays of light and focusses them on the retina, which is the equivalent in the human body to the focussing screen of our cameras. The retina is connected with the brain, and so the image formed on the retina is conveyed to the brain and produces an image of the object we are looking at. We must now proceed to another point in connection with the human eye, viz., the duration of time required for a stimulus of light to act on the retina and produce a definite sensation. We cannot estimate this exactly, but we know it is very short, as, otherwise, we should not be able to see an electric spark, which is almost instantaneous in its appearance and disappearance. Further, this momentary stimulus excites activity and change in the retina which lasts a measurable period. This duration of the sensation after the stimulus has ceased may be so pronounced, when the stimulus is strong, as to give rise to a definite "after-image." We can see this for ourselves by looking full at the sun for a few minutes and then turning away, when we shall see an after-image which may last some time, and is very appreciable. If one stimulus follows another at a very short interval, we get what seems to be a single stimulus, but which obviously is really only a combination of the two separate stimuli, coalesced into one.

Adopting the Young-Helmholtz theory of colour vision (which I fully explained in an article in the JOURNAL of January 18th, 1901) we are fully aware that we can form white light by mixing the three primary colours together, and, again, since we also know that the human eye is not capable of differentiating between colours, provided the stimulation of the nerve fibrils producing these colours come sufficiently close after one another, it therefore follows that, if we take a piece of glass or paper and rule it with fine parallel lines of the three primary colours one after the other—i.e., red, green, violet; red, green, violet, and so on—the sensations produced by their respective stimuli will follow so closely after one another that the eye will not be able to differentiate between them, but will blend them together, and, consequently, we shall get the sensation of white light. Of course, if the lines are ruled too coarsely, the stimuli thereby produced will not follow sufficiently rapidly after one another, and we shall then see each colour separately. It has been found out by experiment that, if a piece of glass or paper is ruled with three hundred lines to the inch, i.e., one hundred lines of each primary colour to the inch, the eye cannot differentiate between the sensations produced by each stimulus, and, consequently, we perceive the glass or the paper as if no lines were there at all, i.e., we perceive it as being white. This effect is rendered better by holding the glass or paper a short distance from the eye, say, about a foot or so away, as then the respective stimuli are not so strong, and the fusion of the colours is better. Now, of course, it obviously follows that to produce a colour, all that it is necessary to do is to cut off those rays which we know are in the three colours, inasmuch as they are a portion of what white light is, which are not wanted to form the particular hue we require, and the result will be that we shall have only the properly-proportioned constituents left, the blending together of which will produce the colour we want. Now, the question arises, by what means are we to get this cutting off of the rays that we do not require? Here, again, the answer is self-evident. We simply block them completely out by cutting them out with black, or, in the case of certain colours, it may not be necessary to completely annihilate them, but rather to only tone them down. We do this, of course, by using a lighter shade of black, and thus prevent all the rays from that particular colour passing through.

Now, all this toning down or complete destruction of the respective portions of our three primary colours can be photographically performed with the very greatest nicety. As every photographer knows, an ordinary photographic negative consists of an image of various densities corresponding to the several intensities of the illumination of the object; therefore, if in contact with our dry plate we place a piece of glass ruled as described above, we shall obtain what we want. This is very obvious, but I will explain it again. When the light passing through the lens falls on the red line of the screen, the effect is to prevent all rays but the red from passing through. Now, let us suppose that we are taking a photograph of a lady with a red dress on. Here we shall find, on developing our negative, that the dress is composed of a black deposit. Examine this with a magnifying glass, and you will see that what you took for a continuous black deposit is not really so, but only a third of the area of the negative, in that portion devoted to the dress, is black. Why is this? Well, simply because the only rays that formed that portion of the negative were of a red colour, and consequently, were only able to pass through the red lines; no light having passed through the green and violet lines, the plate underneath them has suffered no change, and so it appears transparent. Now make a positive from this negative, and the reverse is, of course, observed, viz., that there are now two black lines to every white line that the dress shows. Now, if we place this positive in contact with the screen we placed in front of our dry plate, taking care that the registration between the lines of the positive and the screen are correct, i.e. the transparent line in the positive is under the red line of the screen, we shall get our photograph in colours. Why? Well, look at the dress portion. In the place under the red lines of the screen, our positive is transparent, and, consequently, the red light passes through it, while underneath the other two lines, there is a deep density sufficient to entirely prevent the rays of the light from these two colours passing through and producing an impression on our retinas. Similarly, it will be observed that, if we examine the portion of our picture devoted to the face, here we shall find a deposit underneath those lines of our screen which are not required to form the flesh tint, and the only light which passes the screen will produce, through the stimulation they cause to our nerve fibrils, the sensation of the colour. Should two of the lines of our screen pass light through, then, owing, as I have already explained, to the rapidity with which the stimuli produced by these two rays respectively follow one another, the nerve fibrils in our eyes are not capable of differentiating between them, and so they become fused together, and produce the sensation of the mixed colours. This application of a mechanical contrivance to this characteristic of the eye is, indeed, very clever, and will be greatly appreciated by those who have clearly followed my remarks.

Any colour effect which we observe in our picture can be explained on this principle, which I have endeavoured to explain as clearly as possible, and it will be found to be most interesting to take the different colours and analyse them for oneself with the aid of an ordinary magnifying glass. These colour pictures may be as easily produced on paper as on glass, for, instead of having the parallel lines ruled on the glass, we can have them printed on the paper, which is then coated with a sensitive emulsion, which, owing to its thinness, is transparent enough for our purpose; then we make a print in the usual way from the negative we have taken through the ruled screen, and if we register our lines correctly we shall of course get our picture in its correct colour values. Naturally, should we place the red record over the blue line, the result will be completely wrong, not to say ludicrous. These paper prints are in some ways preferable to the coloured transparencies, as the contact between the colour lines and the positive is more optically perfect, owing to there being no air space intervening, and, consequently, no matter at what angle of incidence we look at our picture, it will always give correct colour values; while, in the case of the glass positive, if we place our eyes too much on one side, owing to the air space between the screen and the positive, we may see green when it ought to be red. The remedy is obvious, viz., hold the positive straight. Now, the only obstacle to the immediate realisation of our scheme is that the characteristics of the photographic plate and the eye are not the same. To the eye there is no impression, that we are aware of, produced by any stimuli beyond the violet rays; but, if we throw the spectrum on to an ordinary photographic plate, on developing the plate we shall find that there is a very perceptible action beyond the visible violet portion. This action will be also much more pronounced when we use strong sunlight for our experiment, and in this case we shall, moreover, observe that there is what we may call an exaggerated action in the visible violet and blue portion. Now, it is obvious that, since our unaided eyes do not observe these phenomena, we must get rid of them by some means, as, otherwise, our colours will be wrong. Fortunately, we can very easily fulfil our desires in this direction by the following simple method: If we place a piece of glass coated with a film of gelatine, which is stained a pale yellow or lemon colour, in front of the lens, we shall find that under normal conditions the ultra-violet rays will be cut off. If the sun, though, is shining at the time, we shall have to stain our films to an orange colour to keep the balance of the colours correct. We, further, can assist the action of these "ray filters" by staining the dry plates on which the photographs are taken. It requires, I fancy, no explanation, after what I have already written, when I state that these dry plates are adjusted, as regards their chromatic properties—that is, their capacity for rendering the colour values in the negative correctly—to the densities of the lines in the three-colour taking screen. Naturally, if we either have our filter in front of the lens too darkly stained, or if we stain the dry plate itself too deeply, we shall go and cut off rays of light which are visible to our eyes, and, therefore, are required for our work. You will, therefore, understand that the filter in front of the lens has to be endorsed with the following properties:—

1. The capacity to cut off the ultra-violet rays.

2. The capacity of toning down the too pronounced violets and blues, when the light is strong.

3. The capacity of performing 1 and 2 without interfering with the action of the other rays, or of causing a disproportionate action of these other rays.

You will now understand that the requirements to produce a correct colour-value negative resolve themselves into three practical working details:—

1. The filter must be of a density to adapt itself to the circumstances of the light at the time the photograph is being taken.

2. The lines of the screens through which the image formed by the lens has to pass to be split up into its three primary characteristics must be parallel and of an equal width, and sufficiently finely ruled.

3. The dry plate itself must be adjusted to the intensities of the screen and the ray filter.

I do not fancy that there is anything here that requires any further explanation at my hands, as the facts are very self-evident after what I have already stated.

As regards the characteristics of the "ray filter," or, to use a very much better term, the "chromatic balance shutter," it must be capable of adapting itself to the conditions of the light at the time of photographing our object. When the sun is shining we have a disproportionately strong action of the blue end of the spectrum; we, therefore, to get our chromatic balance, must tone down these rays by using a chromatic balance shutter of an orange colour. When the sun is not shining or the light is not very intense, were we to use this same orange shutter, we should be cutting off normal blue light waves which are required in our photograph, and therefore we should get a predomi-

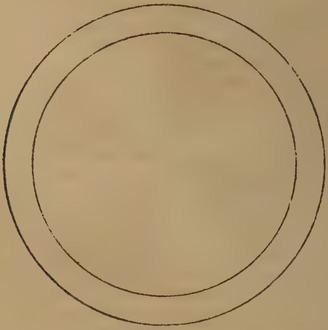


Fig. 2.

nance of the red and green colours. We must, therefore, use a chromatic balance shutter of a lighter shade of orange, e.g., pale yellow. This will have the effect of cutting off any ultra-violet rays there may be about, but will not cut off any of the visual rays. Inasmuch as it is a nuisance to carry two chromatic balance shutters about with us, the difficulty has been got over by making them so that our two requirements may be fulfilled in the one instrument. We have a circular frame which fits into the outside flange of our lens. In this frame there are three pieces of mica—one of them is stained pale lemon, and the other two are stained an orange colour. The pale lemon one stretches across the whole area of the frame, forming a casework of pale yellow; the two orange ones are in the form of sectors of equal proportions; we can, therefore, cause these two orange portions to either overlap one another, in which case our frame will show that half the area is composed of a pale yellow ray filter, and the other half of a double thickness of orange filter; or, if we wish to, we can, by moving one of the orange set of sectors. I should have, perhaps, previously mentioned that the lemon filter and also one set of the orange sectors are fixed, but that the other set of the orange sectors is movable, so that you can move it so that it falls over the exposed portion of the lemon filter; or, by turning it in the opposite direction, you can make it fall over the other set of orange sectors—have a ray filter which consists of the lemon base and an equal area of orange filter. The various diagrams may help to explain this chromatic balance shutter.

In fig. 2 we have diagrammatically represented the appearance of our chromatic balance shutter, with only the lemon ray filter fitted in the frame. In fig. 3 we have our complete shutter, consisting of the lemon and one set of orange sectors fixed, and the other set movable by means of the projection, H. In fig. 4 we have this same shutter with this second or movable set of orange sectors closed over the exposed portions of the lemon, which are illustrated in fig. 3. It will be noticed in fig. 4 that H is now at B, whereas at fig. 3 it was at A. The points A and B are points on the rim of the frame of the chromatic balance shutter, A,

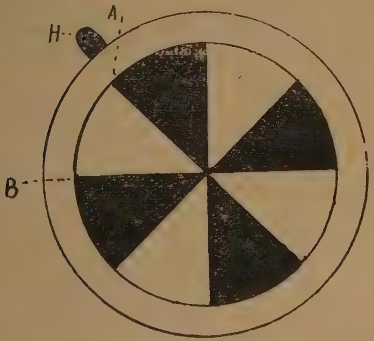


FIG. 3.

corresponding to the position of the movable section when our object is illuminated with diffused light, and B when we are working in strong sunlight. It is, of course, possible to place the movable sector half way between A and B, and this position will depend on the quality of the light at the time. This shutter must be placed in front of the diaphragm of the lens, as otherwise the rays passing through it would not cross and blend together, and so we should get a patchy negative owing to the differences of the light intensities falling on it.

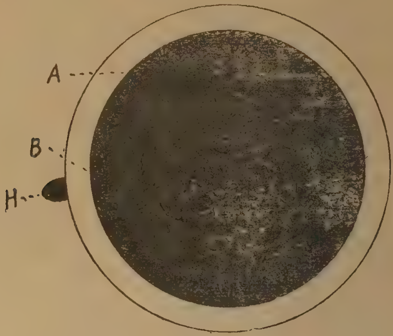


FIG. 4.

THE SUN AND THE STUDIO.

By G. Watmough Webster, F.C.S.

At the present time, now that gelatine plates have attained such a pitch of perfection as regards rapidity, any one contemplating building a studio can afford to be exacting in his requirements for artistic lighting. Time was when a great glare of light was almost welcomed, as conducing to increased rapidity, though there have always been many photographers with whom artistic results were first and rapidity of exposure second. A large number of studios were. and some are even now, little better than hot-houses, to sit for a portrait in which was grave discomfort to the sitter, and on busy days barely endurable by the photographer for several hours at a stretch—"Glass, glass everywhere, and not a spot of shade," to adapt well-known lines. The cause of this intolerably high temperature was, of course, the sun's direct rays entering the studio to a greater or less extent. Thin wooden walls and imperfect ventilation had their share in the effect; but the entry of sunbeams was the prime factor. Hence, if the rays could be prevented from entering, a studio would naturally be no hotter than any other room. The traditional "three courses" are open—the studio can be erected under a high wall or lofty building: it can be designed on such lines in conjunction with a suitable aspect that the sun cannot enter: or, finally, a system of screens and blinds to exclude or modify the direct rays can be adopted.

Taking the last item first, blinds of jaconet or tracing cloth will be found useful, the tracing cloth being the most efficient, but only usable on rollers, or stretched on frames, as it will not fold like a pliable fabric. An outside erection for screening the rays may take the form of louvre boards at a suitable angle lying on the roof, or a tall structure may be erected at a suitable height externally to the building. (It would be necessary to strengthen it securely to withstand occasional gales, and it might take the form of louvre boards to offer less resistance.) Further, if, notwithstanding all these precautions, the sun gained admittance when near the meridian, an effective help will be found by fixing at a height of about seven feet a solid obstruction, a kind of false ceiling in the studio itself, and this would prevent the sunbeams falling between sitter and camera. I once adopted this plan with advantage a good many years ago in the old wet-plate days. Many of my negatives in the middle of summer of the first year with a new studio had parallel streaks from head to foot, and at first I put them down to developer streaks from holding up the plate for inspection for too protracted a time. Eventually I discovered that the sun, which in the early part of the year never entered the room, began to do so towards midsummer, and the streaks were caused by the window-bars blocking the sunbeams, and making breaks in the sun's rays that fell between sitter and lens. A false ceiling was erected to receive the direct rays, and the effect described vanished. The screen was just high enough to avoid obstruction of the background when the camera was at the furthest possible distance from it.

If we now consider the case of a building or wall external to the studio, we shall find that the same considerations that govern the designing the roof of the studio will be applicable. They are simply the intervention of an obstacle at such a height as will prevent the rays at noon from entering any part of the studio, or any part where they would be deemed to be injurious. This can be best explained by a concrete example, as it would not be possible in the small space of an ALMANAC article to treat all possible or probable constructions. Possibly the most general form is a studio with a central ridge, one side of roof facing south and the other north. It is required to know how high the ridge should be to exclude the sun at noon. The roof, it may be said at the outset, would need to be of an unusually steep pitch; but a portion of this may be avoided by causing the ridge-piece to extend outside the roof for some little height. The exact angle is calculated in non-tropical localities by adding the inclination of the ecliptic to 90^0, and, subtracting the latitude of the place, we then get the required pitch of the roof. In round numbers, this is 60^0. In designing the skeleton of the studio, a good plan is to set this angle off on a sheet of paper, and design the studio about it. If so steep a pitch prove to be impossible, the angle will show to what extent the sun's rays will enter the place. With an eight or nine feet wall it would not be found that the upper portion receiving the sun for a distance of about half a yard would do any harm, but the lower the walls the greater the heating effect of sun rays in the room. It is not possible here to further consider the way to treat the rays as the day wears on, and they come from a different quarter; but I may conclude with a general rule for calculating the height of the ridge above the wall plates for entire interception of sunbeams.

This height is simply the tangent to the angle (which we have taken at 60^0). The tangent of 60^0 is 1.7321. Hence, in round numbers, the highest part of the ridge (be it the ordinary ridge, or one extended as described) should exceed the height of the walls by very nearly one-and-three-quarter times half the width of the studio; or, to simplify this, we might say for every foot the studio is wide the height of the ridge above the wall must be ten and a half inches. Almost every mathematical work has a table of "Natural Tangents," and with roofs of lower pitch the extent to which the sun would gain entry will be easily found. The defect in height of the ridge will give the distance below wall-top that the wall will receive the sun when at its greatest altitude.

SOME PRACTICAL NOTES

By EDMUND J. MILLS, LL.D., D.Sc., F.R.S.

URANIUM TONING.—This is usually effected by pouring a weak solution of uranyl ferricyanide on a bromide print until the desired result has been attained. It is generally supposed that the silver of the image reduces the soluble ferricyanide to insoluble ferrocyanide. No doubt this is to a great extent the case; but I do not know of any chemical equation capable of expressing the entire change. The change itself is of the nature of an explosion—as when hydric peroxide is decomposed by finely divided silver. Under similar conditions, I have traced the formation of potassic cyanide. This would account for the invariable solution of some silver; for, if the print be washed with ammonia water, the uranyl ferrocyanide is divided off, and the image is weaker than it was before. In my experience uranyl acetate produces dingy tones; with the nitrate these are always brighter—somewhat scarlet, indeed, at low temperatures.

The permanence of this method of toning has been called in question of late. I have, however, a number of lantern slides so toned several years ago, which exhibit no alteration. On the other hand, a rather old framed print has begun to "bronze" at the edges. The safest plan seems to varnish. One of my large prints, which was long since mounted and twice coated with copal varnish, has remained absolutely unchanged. Copper-toned prints or slides should evidently be protected in the same way.

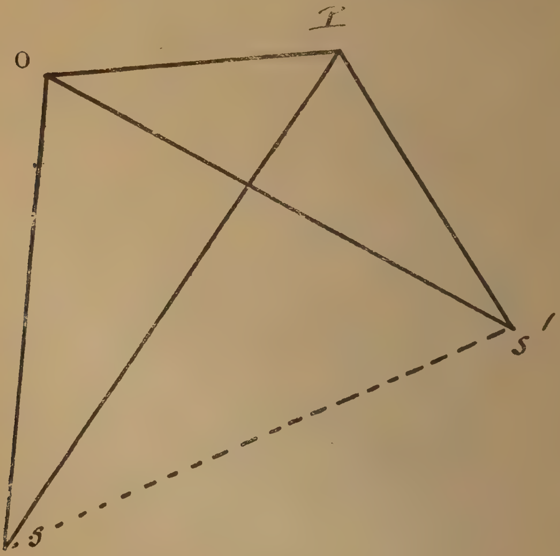
Lantern Slides.—Some time ago, I had occasion to tone some lantern slides green. This was done in the ordinary way, i.e., by bleaching with plumbic ferricyanide, and treating successively with bichrome and ferric ferricyanide. The slides seemed quite satisfactory when examined by white light. When, however, they were shown by limelight, the green tint was much degraded, and in some places entirely destroyed. On examining the glowing lime, a large area of brilliant red was seen to surround the white portion; and this, no doubt, was the cause of the trouble. The difficulty was got over by using green cover-glasses, or putting a green glass between the slide and the light.

Shrinkage of Films.—Ordinary firms on glass plates have a scarcely perceptible shrinkage, after developing, etc., and drying. The case is different with films on celluloid. As no quantitative results seem to have been published I should like to place on record that the shrinkage of a well-known brand of celluloid film is 0.282 per cent.—an amount far too large to be neglected where accurate work is required.

Vanadium Solution.—As mentioned is last year's Almanac, this solution is a wonderful energiser of light change in chromic tissue—indeed, of many chemical changes. It would be well worth while to try it in various departments of photographic work, e.g., developing, toning, and colour-sensitising. A small quantity is easily made as follows:—Take 1 gramme of ammonic vanadate and evaporate to near dryness with 2 drops of glycerine and about 20 drops of strong hydrochloric acid. The residue will be completely soluble in 100 cubic centimetres of water faintly acidulated with hydrochloric acid. The solution has a green-blue colour. Only a few drops (of the above strength) will be required for about half a pint of ordinary reagents. Such a proportion has, within my experience, doubled the speed of chromic printing.

Photo Surveying.—As this beautiful method is beginning to awaken some interest in this country, I may draw attention to an artifice—especially applicable to near distances—when the usual base-line cannot be measured between the camera positions.

Let these be SS¹. At some convenient place in the foreground measure a base OP; and at O and P set up signals of known height. Erect the camera first at S; bring the image of the signal at O to centre, and photograph. Do the same with the signal at P. Measure the height of the images on the negatives, and thence calculate the distances SO, SP. The triangle OSP is then completely known; its angle OSP can be easily verified from the negatives. In a similar manner, determine the triangle OS¹P. Plot out from a line OP of any suitable length; the scale is thus fixed. The distances are conveniently set off from O and P respectively by means of compasses, e.g., OS and PS are radii of circles which intersect at S. Join S,S¹, which will be the station base-line to scale.



Even when the ordinary base-line SS¹ can be measured, it is well, if time permit, to proceed as above indicated, as an independent check on the work. The unknown SS¹ can, if desired, be calculated trigonometrically.

A FEW PRACTICAL HINTS IN CARBON PRINTING.

By E. W. Foxlee.

In the article I had the pleasure of contributing to the Almanac last year I pointed out how the carbon process was the simplest one that amateurs could employ. During the past year there is no question that the employment of this process has been extending, alike with professionals and amateurs. This, in great measure, has been due to the fact that the imaginary difficulties in its working that once existed in the minds of many have been largely dispelled.

Just now there seems to be a penchant for "local treatment," for we are frequently reading of methods of local intensification or reduction in negatives, also local treatment in the development of platinotypes and prints by other processes, as well as local toning in prints, etc. Now, there is no process that I know of that lends itself so well to local treatment, and with so little delicacy in handling, as the carbon process. No chemicals are required—all that is necessary for the work is water at different temperatures.

When local treatment is desired, it is best to take it in hand soon after the tissue backing is stripped off, and the unacted-upon pigmented gelatine washed away sufficiently to roughly indicate the image. Then, by applying hot water where it is desired to lighten the picture, and cooler water to others that are desired to be darker, so as to restrain the development of them, in this way the lights and shadows of a carbon picture may be emphasised to almost any extent. If it is desired to subdue them, a reverse procedure is adopted: the hotter water is applied to the shadows, and the cooler to the lights. A camel's-hair brush, or even the finger if carefully used, may also be employed to hasten the removal of the pigment locally without fear of injury to the picture. With judgment vigorous prints may be obtained from comparatively flat negatives. So also can harmonious ones be made from hard negatives, particularly if the tissue, before development, is exposed for a brief period to light.

If one wants "enamelled" pictures, the carbon process, again, is the simplest method of producing them. All we have to do is to rub a glass plate over with French chalk in the usual way, and then coat it with enamel collodion, allow it to set, and then place it in a dish of water till the ether and alcohol are washed out of the film. The exposed tissue is then squeegeed upon it, and afterwards developed, as in making carbon transparencies. When the picture is dry a piece of the double transfer paper is squeegeed upon it, and on that a piece of the waterproof backing—such as is sold for backing glazed silver prints—is also squeegeed. When the whole is dry it is stripped from the glass, when we have a picture with the highest gloss, and at the same time one that is undoubtedly permanent.

Sometimes it is desired to produce prints with a tinted margin. This is as easily done with the carbon process as with any of the silver ones, and, indeed, with less trouble and better registration if the following simple method be adopted. Suppose, by way of illustration, we have a cabinet portrait to deal with, taken on a half-plate.

Take a glass plate the same size as the negative, and on it stick with indiarubber solution a piece of black or yellow paper a little larger than the glass. Then trim off the edges of the paper so that none projects. Now take a cutting shape of the size and form desired and place on the black paper, then with a sharp penknife or, preferably, a wheel trimmer, cut neatly round the edges with sufficient pressure to cut clean through to the glass. Now remove the outer mask, which the rubber solution allows to be easily done without tearing, leaving the disc one in situ. The outer mask is then fixed on the negative with rubber solution, taking care that the edges of the paper and those of the negative exactly coincide. We now have a mask and disc that are in accurate registration with one another. In use the negative is pressed closely in one corner of the printing frame—say, for convenience, the top left-hand one—and the tissue placed upon it, this also being pressed closely in the corner. The picture is then printed to the requisite depth. The most convenient frame for the purpose is one of the old form with plate glass. When the print is done the negative is removed, and the disc mask put into its place, and the printed tissue put upon it, both being pressed closely in the corner as before, and the second printing made. In this way the most accurate registration may be secured with less trouble than with silver printing, although the printed image is not a visible one.

THREE-COLOUR LANTERN SLIDES.

By Alfred Watkins.

In the 1899 Almanac I gave some bits of practical experience in negative and positive making for the kromskop, the article being, so the Editor remarked in a foot-note, an exception to the fact that no English photographer had at that time published the result of practical experiences with the three principal colour processes. The kromskop, perfect as it is, I only regarded as a temporary instrument, as the production of three-colour slides is much more useful, for they can be shown with any ordinary lantern, mixed with plain slides, and are also available for examination without any instrument. Fortunately the same negatives are available for both processes, and, in my experience, those which gave especially good results in the kromskop also gave pictures of similar character in coloured films.

The process is that of super-imposing three positives, stained or dyed with the three secondary colours (yellow, pink, blue-green). Mr. Ives and other workers initiated it some years ago, and, although Mr. Sanger Shepherd has done good work in putting it into a practical commercial form, it seems a mistake to call it by his name, as only some minor details have been initiated by him.

The translation of Von Hübl's article on the subject on page 813 of the Almanac for 1900 provides full and valuable details, sufficient to ensure success, and my present object is to supplement this with some points gained from practical experience. First, with regard to providing suitable celluloid films. The flat (not rollable) films coated with gelatine emulsion are required, and it is absolutely necessary to find a brand in which the gelatine is soluble in hot water. (A trial should be made on this point.) Most makers harden the emulsion, but I found both Mawson and Fitch's films suitable. The article mentioned gives details of sensitising these films with bichromate, and printing from them as in the carbon process, but through the celluloid, the silver, only playing a mechanical part, being dissolved out. After printing they are developed in warm water, and the gelatine image (in slight relief) dyed.

The Dye Solutions.—Those given in the Hübl article I found quite workable, but the washing solution and the glycerine recommended I think unnecessary. A quick dip in water clears off surplus dye. The only point which struck me with the Hübl dyes was whether naphthol yellow would not be sufficient without the methyl orange; it is certainly rather slow at work, but I doubt whether a pure yellow ought not to be adhered to. If a mistake is made in dyeing, the colour can be discharged by long soaking, and the process recommenced. I did not find it a very good plan to dye too deeply, and then wash out part of the colour, as the edges of trees, etc., were apt to wash out more than other parts.

The three dyed films have (to make a lantern slide) to be fastened in register between two glass plates, and if perfect transparency is required all the films should be cemented together with Canada balsam. I did not find the method of adjusting the three films described by Hübl to be a practicable proceeding. If the red film be cut a little smaller than the blue, and the yellow film a little smaller than the red, a binding strip gummed along one edge will bind all together temporarily. The procedure is first to fasten the blue film to a cover glass by the two temporary bits of binding at the sides, and then adjust the pink film in register, fastening this in the same way; then adjust the yellow film in register, and fasten a wide strip of lantern binding along the top edges of all three films and the cover glass. A strong "bull-dog" letter clip will be useful to hold the films temporarily together. The small bits of gummed binding are then removed, leaving the one strip at the top, which acts as a kind of hinge. The clip is placed over the hinge to strengthen it, and all three films bent back to a curve; a pool of the prepared Canada balsam poured on the centre of the cover glass, the blue film pressed down on this, the other two films bent back, while a pool of balsam (about the size of a shilling) is poured on the blue film. The same thing is done on the top of the pink film after it is pressed down, and the top yellow film is pressed down in its place. Then the last (fourth) pool of balsam is poured on the top of the films, a clean cover glass put on, and the whole pinched together with two good letter clips. Two pieces of paper a little larger than the slide can be provided to catch the squeezed out balsam. It cannot be denied that mounting the films requires some manipulative skill. The slide (held by the clips) is kept in a warm place for a few days to harden, the extra balsam scraped off, the slide cleaned with methylated spirit, and bound up with wide binding. When comparing notes with Mr. Howdill at Oxford this year, I found that both of us had omitted to cement together those slides representing stained glass windows, the translucent effect suiting the subjects. But most subjects are much better cemented together.

The Canada Balsam.—The composition of this preparation is most important. Mr. Sanger Shepherd advises that the films should be varnished before mounting in balsam, evidently to protect the colours from the balsam. The varnishing is a disagreeable extra process; and I regard it as quite unnecessary if the right solvent is used for the balsam. Fortunately we can fall back on the long experience of microscopic mounters in the selection of a solvent. Mr. A. C. Cole, in his "Methods of Microscopic Research," says: "Xylol tends rather to preserve than to destroy the aniline colours, which are undoubtedly adversely affected by benzol." Hardened balsam—which is natural Canada balsam dried in a cool oven—is redissolved in xylol to make a thick treacle-like solution. I have found no "running" of the colours when this is used without the preliminary varnishing of the films. The balsam furnished by Messrs. Sanger Shepherd (smelling of turpentine) was neither xylol nor benzol balsam, and, in my experience, was exceedingly slow in drying.

The Blue Image.—Mr. Sanger Shepherd has adopted the plan of using (instead of a dyed celluloid film) a print on an ordinary bromide lantern plate, converted to a blue image by a well-known process. The plate is used as one of the cover glasses of the slide, and there is therefore one film less to cement up. There are undoubtedly advantages in this plan; and it yields good results. There are one or two disadvantages. The steepness of gradation of the image is very apt to be different to that of the other two films, as it is made by quite a different process. There is no power of altering the intensity of the colouring after the lantern slide is made. I am not sure that the blue is always the right colour, there being often too little green in it. I give particulars for converting the black lantern positive into a blue print, but do not give it as being identical with Mr. Sanger Shepherd's solutions and method, which might possibly be better. Any lantern plate which gives a black image is exposed on the red negative—developed, fixed, and washed in the ordinary way—a rather more fully exposed image than the usual lantern one being desirable. This is soaked in a solution of potassium ferricyanide (say, ½ oz. to 10 oz. of water) until thoroughly bleached, then well washed, and placed for a few minutes in a solution of iron perchloride (about 1 in 100), and, after a slight rinse, placed in clean hypo solution. Mr. Pringle gives a warning against these solutions being in the least alkaline, which leads to an improper tone of blue. The plate is washed and dried as usual. This blue image is printed from the front of the film, and is therefore reversed to the other two films, which are printed from the back through the celluloid. In printing the celluloid films, by the way, the backs must be cleared from bichromate by means of a damp rag. I have found that in some cases a great improvement can be made by printing a fourth under-exposed image in pale grey on an ordinary lantern plate. This adds grey to the shadows, and gives solidity. I used the red negative for this print. I do not attempt to give details of the negative-making which was treated in my 1899 article, but should remark that, although I have tried separate plates for the three, I strongly advise that a repeating back, in which all exposures are made on one plate, is a far more convenient arrangement. Both Mr. Howard Farmer and Messrs. Lumière have recently given useful information on the making of the colour screens.

THE THEORIES OF COLOUR-VISION.

By PHILIP E. B. JOURDAIN.

IN photography of recent years the subject of colour-sensation, owing to its connection with indirect photochromy, has become of great interest. I wish to draw attention again to Hering's theory, which seems to me to have been discredited by physicists simply because they have not attained clearness about the question to which Hering proposed an answer.[1]

Physics is, owing chiefly to the work of Ernst Mach and his school, gradually freeing itself from that narrowness of view (naïve realism), of which the results are seen in the attempts at a "mechanical theory" of physics and the general application of methods which have shown themselves useful in physics.[2]

A new (monistic) point of view has been indicated by Mach, and I have convinced myself that it is possessed of great systematising value in physics. That the new view also possesses heuristic value cannot now, in view of Mach's own work, be doubted. It is then to be expected that also indirect photochromy will profit by it even in practical details; while, what is of greater importance, chemistry (including photo-chemistry) will ultimately be reduced to a science properly so called; a mathematical science, an end which is hardly conceivable on the grounds of older physical methods (atomic theory, etc.).

THE PICTURE FINDER.

By HECTOR MACLEAN, F.R.P.S.

BY the above title I do not mean the superior critic who finds "undreamt-of possibilities" in photographic prints, and who places photographic artists high above the stars who shine in the heaven of painting. Nor do I refer to the restless amateur whose fond hope is that, by travelling many miles, he may attain to pictorial sublimity. I merely wish to hold forth about that humble necessary adjunct to the hand camera which enables us to judge what we shall catch on our plate.

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[1] An analogous mistake is made by Prof. O. J. Lodge, when he seems to imagine that a law of attraction is intended to be an answer to the ultra-scientific question: "*Why* do bodies attract one another?" ("Nature," vol xxvii. p. 304; cf. Stallo, "Concepts of Modern Physics," London, 1900, pp. xxxi., et seq.).

[2] Cf. Mach, "Beiträge zur Analyse der Empfindungen," 1885, English trans., Chicago, 1897, esp. pp. 1–40, 48 (note). A reference to Hering's colour theory is given on pp. 34, 35 (note).

[3] These researches, which are for a great part mathematical, will, I hope, soon be published.

I suppose every one who reads these lines is aware that to-day the pictorialists depend mainly upon the once well-despised and formerly called detective camera for the obtention of their exhibition works.

In a good many cases this is quite as it should be. For, as a rule, nature, unlike a professional's customer, won't wait while the picture hunter is laboriously and tediously making ready. Besides which, real geniuses—which we, surely, all are—cannot, while the fever heat of inspiration is upon them, stop to fumble about with their heads wrapped up in a black cloth.

To me the wonder is that it has taken people who have the pictorial bent so long to find out that to compose a picture on the ground glass is impossible to those who are most sensitive to æsthetic form and tone, and who may hope for the best. Whatever the plate catches —and it may sometimes almost capture what we admire or desire in a scene—be sure you will not see it on the ground glass. The values are absolutely absent, and, what is more, the inversion of image utterly upsets the line balance as seen by the eye. Such things as planes of definition, are, of course, to be noted—and in some cases one cannot help but consult the screen in order to locate the main region of definition. But in most instances—that is in outdoor pictorial photography—the amateur should from experience, by a consideration of the stop and focus used, know his planes, and no more think of locating them with the ground glass than would a sportsman locate a hare with a theodolite before shooting at it.

This subject grows so fascinating that I am tempted to fill untellable pages. But the space of The British Journal Almanac is too precious for mere artistic vapouring. Enough that the majority of picture-finders which are fitted to the hand cameras in use are all wrong for pictorial composition. Many of these finders are just the thing for snapping at a jumping horse, or anything of the purely recording photography. But when it comes to exercising a critical and informed judgment respecting the æsthetic values in a given scene, the ordinary view-finder is a distinctly troublesome obstacle. In fact, as regards a good many of them, they are less help than is the focussing screen.

Inversion or translation of image, falsification of planes and definition, alteration of scale—these are only some of the objections to composing or choosing a picture by aid of a finder.

After much annoyance with several patterns of complex design, I have come back to the cheap and simple device, such as is fitted to the Goerz-Anschütz hand camera, and is extensively used on the Continent. In this a wire rectangle, having cross wires bisecting in the centre, is fitted to the front of the camera, and a small arm as a guide for the correct position of the eye is attached to the back. When about to expose, the camera is held in front of the eyes, the subject sighted, and the shutter released.

No mental gymnastics are called for; no stooping and dodging needed. What you see you take—or try to take. When you develop and print you have a true impression, or remembrance of what to try and get your print to attain to. With the lens-transmitted view-finder you receive a decidedly false and much depreciated mental impress. The above finder is admittedly a little troublesome at first, particularly when the subject fills the plate to its utmost limit. But in a surprisingly short space of time one learns how to use and how to value such a simple finder.

PHOTOGRAPHING BIRDS' EGGS.

By J. H. Baldock, F.C.S.

One is often asked to photograph objects in a museum, or objects before they are placed in one, as then they are not so easily accessible. A very interesting branch of this work is found in the science of "Oology," and from time to time I have made a number of such photographs, the taking of which is the subject of this communication, and, by the kindness of the Editor, I am also enabled to show, by means of illustrations, some of the results I have obtained.

Those who wish to take up this branch of photography must either make friends with some one who has a museum, or cultivate the acquaintance of a naturalist, who may be persuaded to lend the eggs for the purpose, though few, I imagine, would care to part with eggs of any value; therefore try and get them to allow you to photograph them on the premises. I myself was fortunate in knowing a gentleman —Mr. Thorpe, of George-street, Croydon—who has a good collection, and kindly permitted me to bring home any I wanted to photograph, and those figured here are from his collection.

Most eggs have markings of some kind or other upon them, and it is to these distinctive markings and the size of the eggs that particular attention has to be paid. The markings, of course, must be well and distinctly shown in the photograph; and the best way to indicate the size is to apply a pair of calipers carefully to the eggs, and then, by placing them against a measure, the dimensions in inches and fractions of an inch are easily read (fig. 1). The size of every egg photographed should be taken, but it will be found that they vary in size, and in shape, too, even from the same bird, and I have observed as much as a quarter of an inch difference in length in some of the larger eggs, such, for instance, as the guillemots. It may therefore be useful to give an average, for instance, 3 to 3¼ inches.

There are two different ways in which these egg photographs may be taken, i.e., horizontally and vertically; the former way was suggested by Dr. Shufeldt in the "Photogram" for June, 1901, to whose communication I refer your readers. Personally, I prefer the vertical method, the one I describe, as being quite as good as the other, and I think easier to work. The figure (fig. 2) shows the arrangement of camera, tripod, object, etc., and will, I think, explain itself. The background below the egg must be perfectly white, and good demy paper or thick blotting-paper answers very well. It should be out of focus, and may also be used as a reflector by being placed at any desired angle to the light, which, i.e., the light, must on no account be overhead, but always lateral, otherwise a reflection of the apparatus is sure to appear in the negative.

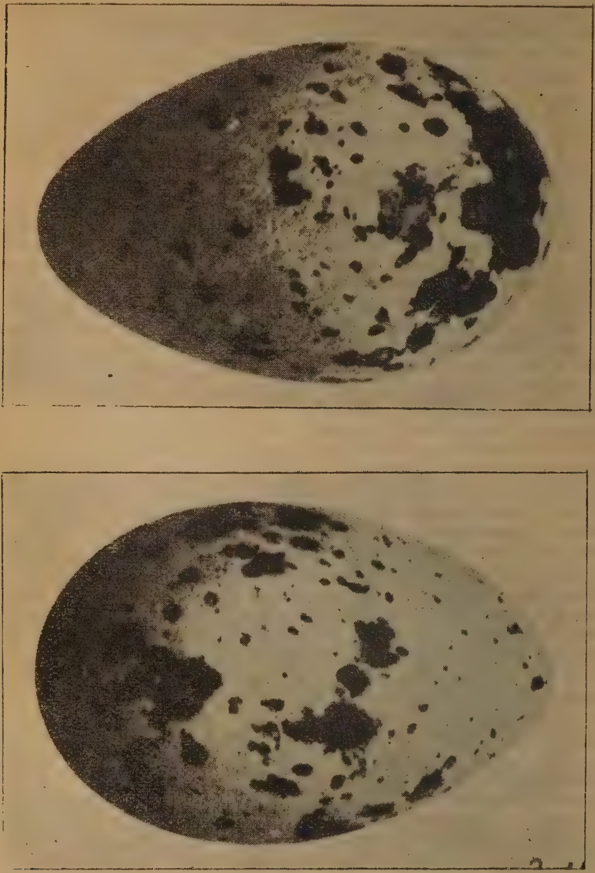


Fig. 1 (enlargement).—Black Guillemot's Eggs, 2¾ ins. (natural size)

1, Tripod, arranged with one leg at the back instead of front, as is usual; 2, camera, arranged vertically; 3, 5½ in. R.R. lens; 4, a sheet of plate or patent plate glass; 5, the background and reflector; 6, the eggs.

The eggs having been arranged on the plate glass, to which they may be attached by means of a bit of wax, or placed on a small cradle of wax, and with their markings well exposed to the lens, focus them on the ground glass of the camera, shifting the reflector so as to illuminate the side away from the light, and get rid of all shadows.

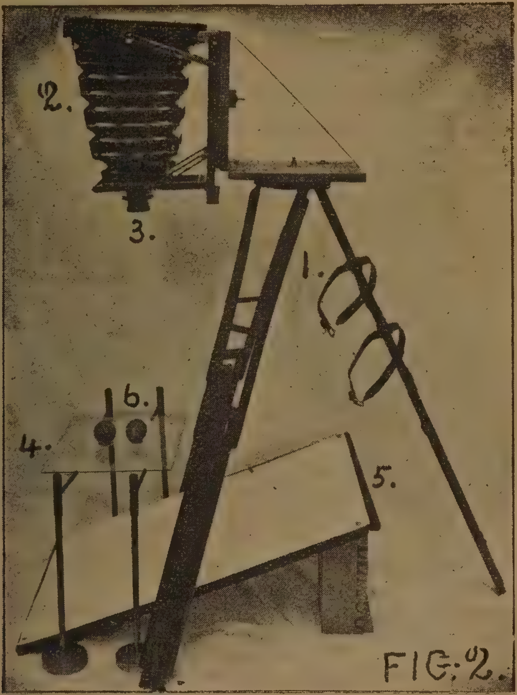
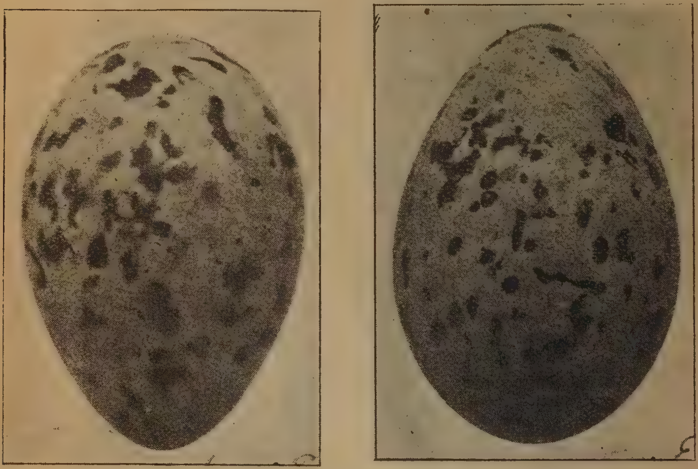


FIG: 2.

Now stop the lens down until the markings and surface of the eggs are absolutely sharp, when the exposure may be made. The exposure is much longer than may be imagined; for instance, as a guide, I may give the actual time, etc., taken in photographing the eggs which illustrate this article. The black guillemot's eggs (fig. 1), on a brilliant day, between 11 and 12 a.m., in a room with a north aspect, with the blinds in the bay half-way down, f-32, on a Cadett spectrum plate, was 1 minute, without a coloured screen, for the negative. The enlargement here shown, on Ilford slow smooth paper, was 6 seconds, f-16, limelight, and developed with rodinal and hydroquinone.

In taking these egg photographs, two points have to be carefully observed, i.e. (1) the avoidance of all shadows. This was fully described in my article on "Shadowless Photography" in the ALMANAC for 1900, page 747, to which I need only refer. And (2) the even illumination of the object. Now, whether the photograph be taken by the horizontal or vertical method, it is obvious that the side of the egg farthest from the light will be less illuminated than the side nearest the light, for the egg itself obstructs the light in that direction. In figs. 3 and 4 you see, not only the great difference in the markings of the eggs laid by birds of the same species, but also the effect produced by the illumination not being as even as it ought to be. One side is, as it were, in the shadow of the other side, and thus the markings are rendered indistinct. The exposure for the negative in these was 1 minute at f-32 on the same day, and under the same conditions as obtained for the eggs shown in fig. 1 (which likewise show uneven lighting). The positive was obtained by an exposure to limelight for 5 seconds at f-16. The eggs shown in figs. 1, 3, 4 are all enlargements. To obtain a perfect illumination, I employ a piece of silvered glass (not shown in fig. 1) placed behind the object. To use it, look carefully on the ground glass, and move the silvered glass about till the visible surface of the egg appears to be evenly illuminated all over. Fig. 5 shows the result thus obtained, and is obviously a great improvement on figs. 1, 3, 4. The



Figs. 3 and 4 (enlargements).—Oyster Catchers' Eggs (natural size).

negative for this was taken on October 20, at 2.45 on a bright day, exposure 3 minutes at f-64, other conditions as before on an Ilford chromatic plate. Being taken natural size, and not an enlargement like the others, a 5½ in. lens was used, with a camera capable of giving the required extension. Thus it is seen that, with two reflectors, one below the glass upon which the object is placed, to get rid of shadows, and one behind the object to secure even lighting, very satisfactory results can be obtained, and, given even illumination, it would not appear to matter whether the object was taken by the vertical or horizontal method, enlarged or taken direct natural size, being simply a matter of convenience; and, as I thought a description of my method might prove of service to some who were desirous of taking up this branch of photography, which, of course, is not applicable to eggs alone, I selected it for my contribution to The British Journal Almanac for 1902.

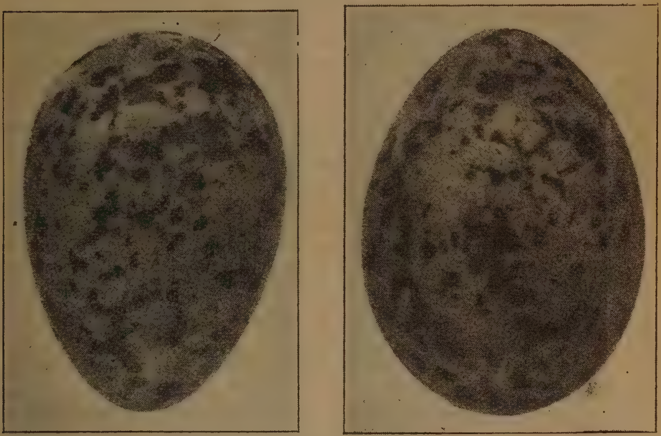


Fig. 5.—Black-headed Gulls' Eggs (natural size, 2 to 2¼ ins.; taken direct).

HINTS ON STEREOSCOPIC APPARATUS.

By J. Leisk.

I was very much pleased to learn from the statement in The British Journal of Photography of Sept. 13 last that a growing interest is being taken in stereoscopic photography by the amateur class of photographers, and therefore, without prejudicing the information on the subject which the Editor then promised at an early date, I think a few general notes on apparatus, etc., based on personal experience, by a fairly successful worker of that branch of the art, may be of interest to readers of the ALMANAC who contemplate taking up binocular work, for I feel pretty sure that when once one has made a successful stereograph, either on paper or glass, he will never afterwards be contented with a small single photograph, except it be a portrait or for a lantern slide.

For successful work a good pair of lenses are the first consideration. R.R. are the best, but good work may be done with single lenses if they cover the plate well, and possess sufficient depth of definition, for it must be kept in mind that nothing fuzzy or out of focus can pass muster in the stereoscope. They should be of about the same focal length as those of an ordinary stereoscope, viz., from 5 to 6 inches; for if a stereograph be taken with a lens of 12-inch focus, and viewed through a stereo pair of half that focal length, the more distant objects will appear unnaturally near.

Do not invest in the so-called "stereoscopic-size" camera and plates. The latter are too narrow, and cause vexation in practice, often forcing one to sacrifice nice bits of foreground, or the tops of buildings, etc., as the case may be. A stereograph being quite effective 4 to 4½ inches from top to bottom of the pictures (although optical conditions limit their width to about two and three-quarter inches for most people's vision), it follows that the ordinary half-plates are the best size, used in a half-plate camera fitted with removable "roller blind" division between the lenses. It should also have a swing back, rising and falling front, and a division in the centre of the cross front, so that the distance between the lenses may be varied to the extent of three-eighths of an inch. The last-mentioned adjustment will be found useful when "composing" the picture on the ground glass, but more particularly so when making stereo transparencies from the negatives; and for making transparencies, the camera should be capable of being racked out to double the ordinary focal length of the lenses, otherwise an extension back will be required. A time and instantaneous shutter is also necessary.

I consider a good rigid stand to be indispensable for satisfactory work. It being important to have the camera perfectly level, to carefully focus and compose the pictures, frequently use the swing back and adjustable fronts. A hand stereo camera affords little chance of success, as a rule, although occasionally one may secure a successful snap-shot, and therefore a hand apparatus is not recommended.

A proper stereo outfit is somewhat heavy to carry, and should not be acquired until one has got over the temptation to snap-shot at anything and everything that takes one's fancy, when, with a little experience of which subjects are most suitable, one may reasonably expect to bring home a successful negative on every plate exposed, for with a binocular camera one is not nearly so much dependent on light and shade as with the single lens; in fact, a bright day with the sun obscured is better than bright sunshine, and, for a similar reason, rapid plates are more suitable for most subjects than slow ones, full detail in the shadows rather than contrast being what is wanted.

In this connection I would say, Avoid films. They are a little lighter to carry, but, when the weight of the carriers is added, that is not much, while, per contra, they are more troublesome to change at night when travelling, more difficult to develop, not so rapid as plates, and, worse than all, a large percentage exhibit defects such as black opaque spots in the negative, or little circular holes, either of which spoil a stereograph, as it is hardly possible to touch them out. I speak of cut celluloid films obtained direct from well-known makers whose plates are always good.

By far the finest form of stereograph is a transparency, and these can be made with less trouble and quicker than paper prints if one goes about it in the right way. There are special printing frames constructed for making transparencies by contact, first from one end of the negative, and then from the other, in order to do the necessary transposing of the pictures without dividing the negative in two. These frames are troublesome to use, requiring both care and skill, but by far the easiest and best way is to make the transparencies in the camera, when all adjustments of the images on the ground glass may be made, including the necessary transposition of the pictures, and the resultant images tested by examination through a pair of stereo prisms before the transparency plate is exposed, and for these I use half-plates coated with "lantern" emulsion, cutting the plate afterwards to the width desired.

For ease and regularity of working, it is best to get a piece of board, say, ten inches wide and thirty inches long. Have a long groove cut longitudinally along the centre towards one end, and wide enough for the shaft of the tripod-screw to slide along, but not allowing the screw-head to come through, and at the other end of the board an upright frame glazed with ground glass is attached, in front of which is a smaller frame or carrier to hold the negative. The latter may be suspended by a thread at each corner, fastened to tacks in the top rail of the upright frame, by which threads it may be raised, lowered, or tilted as desired, and afterwards secured in its place by clips, but it is better to have the negative carrier attached to a firmer support, by which it can be raised or lowered or tilted to or from the level, as may be required to level it with the camera, or correct any error in level when the negative was taken.

The negative is now placed in the carrier, upside down and film side away from the camera; the camera screwed to the board through the slot, and pushed backwards or forwards to obtain the correct size of image, and then screwed tight; the images very carefully focussed, and the distance between them adjusted by means of the division between the lenses; the levels also adjusted, and the board placed in front of a window, pointed towards the sky, if necessary, and the exposure made.

A transparency made as above described has its parts correctly transposed when viewed through the glass, and it has the further advantage that, when mounted against a piece of ground glass (or glass coated with matt varnish), the film, being between the glasses, is protected from injury.

A SIMPLE METHOD OF PREVENTING TWO EXPOSURES ON THE SAME PLATE WHEN USING SINGLE OR DOUBLE METAL DARK SLIDES.

By J. T. Hackett.

I have used metal double dark slides with great success for several years, but, as it is not always easy for me to make sure of seeing the numbers on the tags of the shutters distinctly and with certainty, I thought of the following simple method of preventing two exposures upon the same dry plate.

It is this: Get a watchmaker to drill a hole (if you have not a suitable drill, etc., of your own to do it with) right through the top part of the shutter and upper part of the dark slide, about half an inch or rather less from the top edge of the shutter, and about the same distance from the outside of the side of the dark slide. The hole need not be more than one-sixteenth to one-eighth of an inch in diameter.

The above holes are used thus:—After the dark slides have been loaded with the sensitive plates or films, pass a piece of No. 24 white cotton or thin white thread through the holes above mentioned, and tie it firmly in a knot over the top part of the shutter. If a small notch is filed in the top of the shutters, just above the holes, the tied cotton or thread cannot get displaced by accident if it has been tied properly. The cotton or thread must be strong enough to prevent it from being broken easily while tying it in the holes, but not so strong as to make it difficult to break easily when drawing the shutter ready for exposure after the slide has been inserted in the camera. It will be quite obvious to the reader now, that whenever he sees the cotton or thread broken, or missing altogether, he knows for certain that the plate opposite that particular shutter has been exposed; so that, if No. 2 plate gets exposed before No. 1 plate, or that he has made any similar mistake in the exposure of any of the other plates, he will know for certain which plate or plates have been exposed.

I may add that the pieces of cotton or thread need not be adjusted and tied in the dim light of the dark room, but can be fitted in white light, or lamp light much more quickly, and with greater ease and comfort. I usually fit mine near the partly opened door of my dark room.

It is a good plan to paint the number of each shutter of the dark slides in as large white figures as is possible upon the upper part of the dark slides. This can be done by the photographer himself by the aid of a camel's-hair brush and a small tin of white enamel paint.

Sometimes in book-form metal double dark slides the fastenings wear loose and come undone, which fogs one or both the plates it contains. I have had this unfortunate experience. To prevent it occurring again, I had soldered a piece of wire, bent in the form of a loop, upon the opposite side of the slide to that to which the fastening is attached. I then tie a piece of string to this loop, and then through the loop of the fastening, and then tie the string tightly in a bow. This simple dodge prevents all chance of the slide opening by accident while being used. Another plan would be to tie a piece of long string to the loop of the fastening, and then to pass this right round the slide until the loop of the fastening is reached again, and then tie it in a bow tightly as before. I prefer the first method, but either answers well.

BACKGROUND HANGING WITHOUT CREASING.

By J. H. Smith.

A good way of hanging backgrounds without creasing the same is on the theatrical scenery plan. The background is tacked on to a piece of board about six inches wide and about one inch thick cut the required length. Tack the background on the board about two inches from the bottom, using a piece of tape over the background to prevent tearing. Get two brass pulleys, one single and one double. Place the double one on the right-hand side of the board at the back, the single one on the other side. (See illustration, fig. 1.) Place the background up in position, and unroll the same. Place the cord through the single pulley, so that it will run easy, and tack to the roller on the bottom. Bring the other end of the cord through the double pulley; allow enough cord to hang half-way down the background. Now take another piece of cord, and pull through the other side of the double pulley, and tack to the end of roller. Cut off both cords the same length, and tie together. Before doing this sufficient cord must be wound round the roller at each end to bring the background up to the top. (Fig. 2 will explain this.) The boards holding the backgrounds are not fixed, but work in slots, so that a background can be taken down in a moment and another put in its place. (See fig. 3.) One advantage in this system is that a dozen backgrounds can be hung within a space of about three feet, and as the weight is

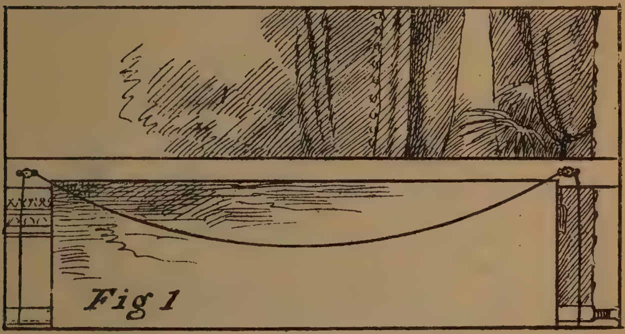


Fig 1

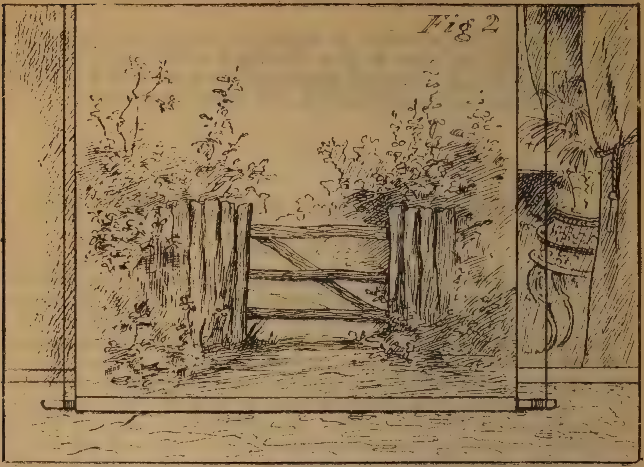


Fig 2

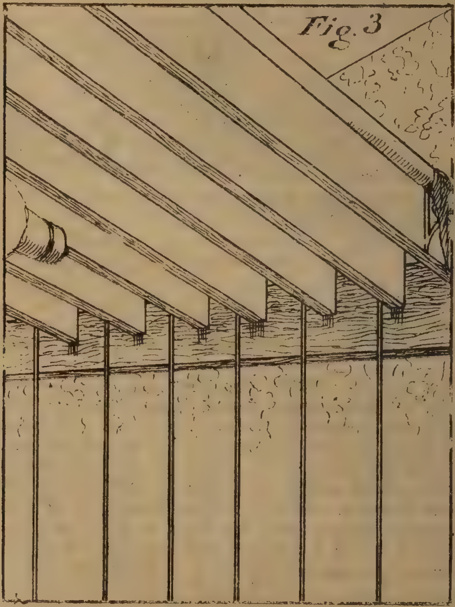


Fig. 3

taken from the top tacked to the board there is never any creasing; the only difficulty is what to do with the cords when the backgrounds

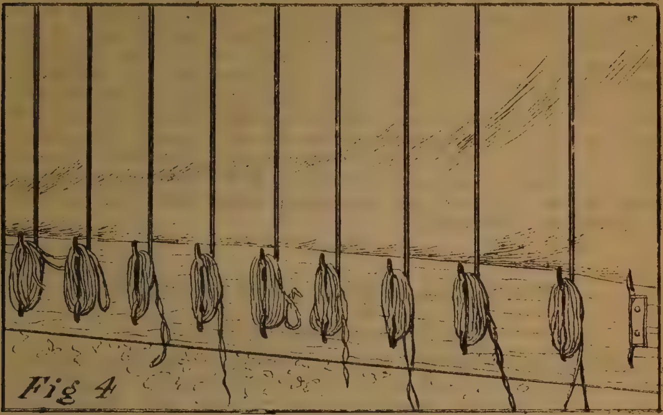


Fig 4

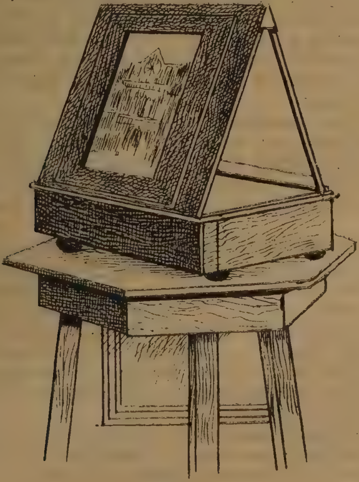


Fig. 5.

are pulled up. This is obviated by winding them on to brass stays—(see fig. 4)—or all the backgrounds can be left down, and pulled up as required. (Fig. 2 will explain the principle.) The cords must run quite upright, about three inches away from the background top and bottom. Equal quantities of cord must be wound around each end of the roller, otherwise they will not run up straight. Continuous backgrounds can be hung the same way, using longer cords. If children's backgrounds are to be hung they will, as a rule, be found too short. In this case a piece of black linen must be sewn on the top to make it the required length. I have tried all ways of hanging backgrounds, and find this by far the best way, as it is impossible, using ordinary care, to crease them; besides, you run no risk of a heavy roller coming down on your head, compelling you, perhaps, to seek the asylum of a hospital through having obtained free gratis a fractured skull or some other serious injury. Any local carpenter will do the work for you at a trifling cost, or you can do it yourself, it is so simple. Try this way of working backgrounds, and you will be pleased with the result.

SELECTING A CAMERA FOR A BEGINNER.

By Rev. F. C. Lambert, M.A.

I am frequently asked this question, "Which is the best camera?" and as frequently I have to reply, "I don't know." Experienced workers will, I fancy, agree with me in saying this. There is no "best." Many are good; but some are better than others for special purposes. The best studio form is not the most convenient for general outdoor work. Again, a good hand camera is not generally suited for the process worker's usual needs. Briefly, then, there is no universal "best." And in selecting a camera the prime consideration is, what are to be its chief uses.

In this note I am presuming that many readers of these pages are consulted by beginners as to choice of camera, and it has been thought that a few jottings on the subject may serve to refresh the mind and memory of my brother-workers who are old enough to have forgotten how serious was this same question to them some years ago.

(1) The beginner, brimful of enthusiasm, will want to tackle any and everything that comes along—waves, trees, portraits, interiors, copying, etc. Therefore it is best for him to begin with a stand camera and focussing screen. The trouble of having to fix up the tripod, etc., will possibly prevent him being quite so utterly reckless in snapping at all manner of difficult, if not impossible, subjects. The focussing screen will educate his eye as to the angle of view, relative size of near and far objects, sharpness of near and distant objects with various stops, etc.

(2) The camera should have not as many, but as few, movements as are at first generally necessary. These may be put in order of general usefulness: (a) reversing back, (b) swing back, (c) rising front, (d) swing front.

(3) Rigidity of parts is essential, and should outweigh lightness, portability, or appearance.

(4) The rigidity of the tripod is equally important with that of the camera, for the camera and tripod in use are one instrument, not two, and vibration or looseness in any part of either may, and probably will, affect the other.

(5) A cheap and shaky apparatus will probably be a source of loss of plates or films, and may prove dear in the end.

(6) Brass binding is not a necessity for English climate, adds but little, if anything, to efficiency, and materially increases cost and weight, without compensating advantages.

DEVELOPMENT OF LANTERN SLIDES.

By Rev. T. Perkins.

It is well known to all photographers who make lantern slides that, provided they use suitable plates and modify their exposures and developers, a considerable variety in the colour of their slides may be obtained, ranging from black through brown and purple to red.

The black tone may be obtained by, among others, a hydroquinone developer containing nothing but hydroquinone and metabisulphite of potassium for one solution, and for the other nothing but caustic soda. The exposure is then a minimum one; by adding to the developer more and more of a third solution containing equal parts of bromide and carbonate of ammonium, and prolonging both exposure and development, the colour may be made warmer and warmer. If any one is preparing a set of slides for a lecture, it is well to vary the tones, for a uniform colour for slide after slide is apt to become very tedious to those who attend the lecture. Although in monochromatic slides it is impossible to imitate nature, yet it cannot be doubted that certain colours are more suitable than others for certain subjects. If we want to make a dozen slides from one negative, having once chosen the colour we think best, we can, after making a few experiments, get all the rest uniform; but, as a rule, we do not care to make three or four experimental slides from each negative, and are satisfied if we can get approximately the colour we wish. The density of the various negatives compared with one another is some guide towards the necesary exposures; but it often happens that we either give too long or too short an exposure to get a slide properly developed in any one particular developer. A method which I have adopted with some success, and which considerably diminishes the number of "wasters," is as follows. I prepare one developer according to the formula given by the makers for securing black tones, and one to which sufficient of the third solution mentioned above is added, to produce a brown colour, and yet another containing a still larger amount of bromide and carbonate of ammonium, enough, in fact, with a prolonged exposure, to give a red colour to the slide. As a black tone is one that is seldom wanted, I aim at giving a tolerably full exposure, and put the exposed plate in the developer containing the smaller amount of bromide and carbonate; if the exposure has been correct, the development can be finished in this, but if the image does not come up within reasonable time I put it into the developer for black tones. This will generally bring out the image. The development may then be finished in the bath in which it was first placed. If, however, it appears that the plate has been over-exposed, then it is at once transferred to the solution strongest in bromide. By keeping these three developers ready, and transferring from one to another, it is possible to save almost every plate exposed, and at the same time to obtain a great variety of colours.

BRUSH TONING FOR P.O.P.

By F. J. Mortimer.

That bugbear of many amateurs' existence, toning P.O.P. prints, would very soon become a pleasure if only the little-used method of brush toning were more generally known and practised. Mr. Otto Scholzig has recommended it for his P.O.P. for some time, but I have found it work perfectly with every brand on the market, and the following formula and method of using it is a modification only of his process. I invariably tone the prints dry, i.e., do not wash them before applying the toning solution, and use a fairly large camel's-hair mop, obtainable for a few pence from an artists' colourman, and a sheet of glass larger than the print to be toned. Old negatives come in handy here. The brush, by the way, should be kept solely for the purpose, and well washed out after use. The bath is made up as follows, and if the chemicals are kept in 10 per cent. solutions (with the exception of the gold, which I usually keep at 1 grain in ½ oz. water) there should be no trouble in making up the toning solution in a very short time as wanted:—

Sulphocyanide of ammonium 10 p.c. solution..	1 fl. drachm.
Water	1 ounce.
Chloride of gold	1 grain.
Phosphate of soda (10 per cent. solution)......	1 fl. drachm.
Saturated solution of borax	2 fl. drachms.

This toning solution is mixed in the order given in a measure, and then poured into a perfectly clean quarter-plate dish (porcelain, for preference). The piece of glass, which should also be perfectly clean, is then held at one corner by the left hand, with the opposite diagonal corner in the quarter-plate dish. A print is placed on the glass, face up, and the toning solution mopped on from the dish, the surplus running back from the glass. The toning takes place in a marvellously short time; in fact, each stroke of the brush leaves a toned streak behind, so it is necessary to mop the solution all over the print very quickly, although with this formula it seems impossible to get uneven toning, and I have experimented with every well-known brand of P.O.P. This seems due to the fact that after a certain tone is reached in one part it goes no farther, and the other parts catch up, so to speak. The prints are fixed and washed in the usual way, and it will be found a good plan to drop each print, as soon as toned, into a dish of clean water, and then fix them altogether. The bath I have given above should tone about eight or nine half-plate prints easily, after which its action gets slower and slower, when it is advisable to make a new one, and, although the use of the gold seems extravagant, I think it is amply compensated for by the ease of toning and the beauty of results. For quickly finishing proofs on P.O.P., the method has no equal, and the advantage of its use when only one or two prints require toning is obvious. The toning can be controlled, of course, by dilution, when the action is considerably slower, but for brown and red tones on P.O.P., when the print really only wants a smell at the gold, I fancy the old tedious, sloppy toning bath and turned-up cuffs holds its own.

BROMIDE TONING.

By Ons.

A very interesting and pleasing method of producing brown tints or bromide paper is as follows. The bromide print, which may be upon any kind of paper, but preferably paper such as Kodak Royal, is treated with a dilute solution of iodine, made by dissolving 5 grammes of iodine in 1000 c. c. of water containing about 10 grammes of potassium iodide. This solution can be used over and over again until exhausted. On placing the wet print in this bath it at once turns blue, owing to the formation of starch iodide, the starch being used to size the paper, and after a time the image will show as a yellowish-white negative image against the dark blue paper. When this is the case all the silver composing the image has been converted into silver iodide. The print is then placed, without washing, in a dilute solution of sodium sulphite or sulphurous acid. This will discharge the blue colour owing to the decomposition of the starch iodide. When all the blue colour has disappeared the print is washed until free from sulphite, and for this reason the sulphurous acid is preferable, as its solubility is greater than that of sodium sulphite. After washing, the print is treated with an alkaline sulphide, polysulphide, sulphuretted hydrogen solution, or sodium thio-antimoniate (Schlippe's salt). The most convenient of these is ammonium sulphide, which can be purchased in solution at all chemists. The potassium polysulphide or liver of sulphur, which is used for precipitating hypo solutions, may also be used. These give a brown colour; Schlippe's salt gives a foxy-red colour. The colour is due in these cases to the formation of a silver sulphide, and as this is a most stable salt the results should be permanent. A solution of chlorine or bromine in water may be used in place of the iodine, but as these are more difficult to prepare, and rapidly oxidise on keeping, and so lose their bleaching properties, their solutions are not so efficient as the iodine solution. When using Schlippe's salt a yellow stain is frequently produced; this can be prevented by treating the print before the Schlippe's salt with a dilute solution of ammonia and washing. The ammonium sulphide of commerce will require diluting to one-tenth of its volume for use. Schlippe's salt gives the best result in a three per cent. solution.

A SIMPLE TOOL.

By Chapman Jones.

There is a little piece of apparatus that every one uses every day, though few seem to appreciate it as they ought, namely a tooth-brush. I do not refer to the actual brush, but to the handle, which, I believe, is invariably thrown away as soon as the brush is worn out. By cutting off the brush end, and filing the end of the handle into a rounded or pointed or screwdriver-like shape, one has at once a neat and convenient plate-lifter, a better instrument than the finger-nail for picking up the edges of prints when in the frames, a paper folder, an apparatus for rubbing down prints with in mounting (a sheet or two of blotting-paper will, of course, be interposed between the surface of the print and the rubber), a convenient "tyre-lifter" for those who cycle, and, in short, a substitute for the finger-ends that will often be able to do what the unaided hand cannot, as well as doing it in a more convenient and more cleanly manner.

A SIMPLE MEANS OF PRODUCING MICRO-PHOTOGRAPHS WITH AN ORDINARY CAMERA.

By Procella.

So far as known, no description seems to have been published of any apparatus used for producing micro-photographs, except that used during the Franco-Prussian War, for copying on a very small scale newspapers and documents to be sent outside Paris by pigeons. It was an elaborate and excellent instrument for the purpose. The object now is to show how any one in the possession of a camera may produce micro-photographs by means of a very simple accessory. Probably very few are interested now in looking at these small pictures; and there are still fewer, it is believed, who know how to make them. When collodion was introduced by Mr. Scott Archer as the medium for more rapid photography, some time in the fifth decade of last century, it became possible both to make very small copies of large objects, and to produce enlarged copies of small ones. It was at first proposed to distinguish these two different forms by the terms alphagraph and omegraph, but the late Mr. George Shadbolt, while editor of The British Journal of Photography, suggested the terms micro-photograph and photo-micrograph, and these latter terms have been universally used to distinguish the two forms from each other ever since, the term micro-photograph being invariably applied to small photographs of large objects, while the term photo-micrograph is used to signify a large copy from a small one. Notwithstanding this general consensus of opinion, however, it is found almost daily that the two terms are used indiscriminately to signify an enlarged copy from a small object. Medical men seem to be peculiarly prone to get confused by the two terms.

The camera to be used for the production of micro-photographs should be one with a rigid front, or capable of being rigidly fixed in that position, while that portion carrying the dark slide should also be capable of being rigidly fixed in the position it is to occupy while the photograph is being taken. The old form of box camera would seem to be the very best form for this purpose. The flange in the camera front, used along with the accessory referred to, was that taking the Ross portable symmetrical and other lenses having the same size of screw. Into this flange there was screwed a thick drawn tube, such as is used for telescope eyepiece tubes, the tube being as large as the aperture in the flange would admit of. A ring was soldered on the outside of this tube, which was screwed to take the screw in the flange. The tube entered into the flange about two inches, and was sprung at the end inside with cuts resembling the latter T placed horizontally. The other end of this tube or jacket was cut with an inside screw of fifty threads to the inch. Another piece of telescope drawn tube was selected about six inches long, which was made to slide easily in this jacket by grinding the two together with rottenstone and oil. A ring about a quarter of an inch broad was soldered outside within an inch from the other end of this last-mentioned tube, and this ring was also cut with a screw of 50 threads to the inch, so that, when this tube was placed inside the jacket and turned round, it could be made to approach or recede from the sensitive plate in the dark slide by a very minute quantity. To enable this to be done easily, this tube has a ring soldered on to its extreme outer end, fully half an inch larger in diameter than the tube. This ring was knurled on the edge, which enabled the fingers to grip it without slipping, while the inner end of the jacket, being sprung, enabled the tube to be rotated by means of the fine screw motion without the least apparent movement of the image on the screen while focussing. The inner end of the inside tube had the universal microscope screw to take the object glasses to be used. Both of the two latter mentioned screws should be carefully and evenly cut, no drunken threads being permissible. Of course, the tube was blackened inside, and a stop placed to prevent reflection of light from the sides. This accessory is really a very simple piece of apparatus, and easily made. The dark slide used was a single one. A carrier was made to fit it, having an aperture in the centre to take plates the size of a quarter-plate cut into twelve pieces. One of these plates was taken and obscured by grinding all over one side with fine emery. This was used for rough focussing, while another was taken and obscured by grinding the outside portions of one of the faces, leaving about half an inch square in the centre untouched. This was coated with a very thin film of virgin wax, and was used for fine focussing. This wax film makes probably the best screen for fine focussing. The glass is rubbed over three or four times with a corner of the wax, gently heated over a lamp, and then spread with the point of the forefinger. Due care is taken to see that the small picture is in the centre of the focussing screen, and that no adjustment for collimation is necessary. The negatives to be copied were quarter-plates illuminated by a 4-in. condenser placed immediately behind them, and in almost close contact with them, their distance from the camera being regulated by the size of the micro-photograph desired with each object-glass used. It was found that with artificial light no other method of illumination would suffice to give an evenly lighted copy. The objectives used were Zeiss 75 mm. and 35 mm. apochromatics. The lamp used was an ordinary paraffin lamp with a half-inch wick placed in the focus of the condenser, and with such a light it was found that with Ilford ordinary plates, and the negative nearly three feet away, using these objectives, an almost instantaneous exposure sufficed. Everything being ready, the picture is roughly focussed by the movement of the camera itself, while the fine focussing is done by the rotation of the tube in the jacket by means of the fine screw. A focussing glass having considerable magnifying power is necessary, owing to the smallness of the picture. The camera may, of course, be so made as to take any size of plate, but it was found that those used were perhaps the most convenient of all, and although not transparency plates, good results were obtained. It will be seen from the above that no focussing screen on a separate frame was used, the focussing glass being carried in the dark slide itself, and removed each time the sensitive plate was put in, thus preserving the perfect register obtained. Probably those who make it their business to do this kind of work may have very perfect and expensive and rigid forms of apparatus, but the above accessory, when used with a somewhat rigid form of camera, does give good results.

PYRO AS A DEVELOPER.

By PERCY J. SLATER.

ALTHOUGH pyrogallic acid as a developer has been largely supplanted by many of the newer developers, it can still hold its own as the best reducing agent for negative-making, not to mention its usefulness in the production of lantern slides.

Many of the newer developing agents are useful for special purposes, but for all kinds of negative-making is pyro useful. I hardly know for which class of work it is the least suitable. With it negatives of almost any quality may be produced by simply modifying the constituents of the developer. For instance, by developing in a solution containing the full amount of pyro, and a few drops of a 10 per cent. solution of bromide, a dense negative full of contrast is obtained. Similarly, by using a solution containing a minimum amount of pyro and bromide, with a full amount of soda or ammonia, a soft delicate negative results. This is, of course, presuming that the exposures in each instance have been fairly correct.

By developing in a solution composed simply of pyro and soda, without any sulphite, a deeply stained negative results. By adding sulphite to the developer in sufficient quantities, a black image is produced. Those who like pretty looking negatives may easily produce them with pyro, by adding a sufficient quantity of sulphite to the solution. There are still many, however, who think that negatives with a tinge of yellow produce the finest prints, and I confess I am among the number. Such negatives can only be produced by using our old and trusty friend—pyro.

For the development of instantaneous exposures, metol and other newer developers are often recommended. Certainly when using this developer the image flashes up very quickly, and appears full of detail. But my experience shows that pyro soda, used without bromide, produces negatives containing more printable detail than those developed in metol.

ALBUMENISED PAPER PRINTING.

By G. T. HARRIS, F.R.P.S.

LAST year in THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC I drew some comparisons between albumen paper and its rival, gelatine-chloride. I should not have returned to the subject this year had there not been many indications in the various photographic papers of an awakening interest in the excellent and beautiful process of albumen printing. Process engravers state that for the purpose of reproduction no print gives such satisfactory results as an albumen print, and when collotype negatives have to be got from paper prints a good print on albumen paper beats all competitors for that purpose. Nor is it the professional photographer only who seems to be taking renewed interest in this process, the amateur also has been eliciting information at certain fountain heads on the production of albumen prints. With such evidences of aroused curiosity before me, it is an agreeable task to outline in a succinct manner the process of albumenised paper printing for small consumers.

The habit of buying ready sensitised printing papers from the dealers has become so steadfast with the individual whose printing is intermittent and small in quantity that any suggestion of home preparation is likely to impress him as being revolutionary and troublesome. The disinclination to prepare one's own paper need not deter any one from taking up albumen for his printing, as several brands of this class of paper are already on the market, and, should any demand for it arise, the dealers are sufficiently on the qui vive to meet it with a good article. Sensitising albumen paper is such an extremely simple operation that some effort to familiarise one's self with it will not unlikely result in the conversion to home preparation. A great argument in favour of home-sensitising is, that when preservatives are used with albumen paper, the best results are not always obtainable, its behaviour in the toning bath may be capricious, and certainly much more gold is necessary. The finest results on albumen paper are to be got with the silver bath in a neutral condition, while ready sensitised papers contain citric or tartaric acid, which, unless very thoroughly eliminated before washing, cause protracted toning and unequal deposition of the gold on the surface of the paper.

Where the amount of printing is moderate in quantity the sheet of albumen paper ($23 \times 17\frac{1}{2}$) may be quartered before floating, by which means simplicity and economy will be ensured. The choice of the paper must rest with the consumer, but I would suggest that a good weight be obtained (not less than a 12 kilo paper), and that deeply tinted surfaces be eschewed. On receiving the paper from the dealer, quarter the sheets and store them flat in a damp locality. The albumenised paper, if kept bone dry, will not lie flat on the silver solution when sensitising, and the silver will run from the surface in tears and streaks. One great factor in the successful floating of albumenised paper and in the avoidance of air-bells is its hygroscopic condition. It should be perfectly limp and tractable, and when laid on the surface of the silver solution there should be no tendency of the edges to curl back.

For the sensitising bath 40 ounces of solution will be a generous supply when quarter sheets are floated in a 12×10 porcelain dish; and the strength most suitable for all-round work is about 60 grains to the ounce. Careful attention to the condition of the silver bath will do a very great deal towards making the subsequent operations of printing and toning both certain and even in quality. Add sufficient solution of carbonate of soda to the silver bath to neutralise any free acid, and, if the bath becomes discoloured from use, precipitate the organic matter with permanganate of potassium, followed by sunning. If the albumenised paper is sufficiently damp no trouble need be experienced even by the novice in floating it on the surface of the silver solution. Take a corner of the quarter-sheet between the fore-finger and thumb of one hand and the diagonal corner between the fore-finger and thumb of the other hand, bring the hands close together so that a convex shape may be given to the albumen surface of the paper, let this convex portion touch lightly upon the silver solution, then steadily lower the two hands in opposite directions until the paper lies evenly upon the surface of the solution. If air-bells are feared, raise the paper by one corner and examine the surface, when, if present, they may be easily broken by touching with a glass rod. After three minutes' flotation remove the sheet by drawing it slowly across the edge of the porcelain bath (to remove surplus solution), and hang up to dry by suspending it in an American clothes clip (several of which screwed to a length of wood make an efficient drying-rod for silvered paper). When the silvered sheets are dry they may be placed face to face, and stored between boards with heavy pressure; so stored the paper will keep perfectly good for at least three weeks. They may be stored by sandwiching them between sheets of pure blotting-paper saturated with a 50-grain solution of sodium acetate, whereby the period of keeping in good condition is considerably extended.

The printing of albumenised paper in no way differs from gelatine-chloride, except that it is somewhat slower. Shade printing is advantageous when the negatives are thin; in fact, diffused light at all times is to be preferred if the negatives are of average density. Gelatine negatives are so readily reduced that there is no excuse for having negatives which require sun-printing. When the operations of washing, toning, and fixing come to be carried out, albumen paper is simplicity itself compared with gelatine. The temperature of the water used for washing, also of the toning and fixing baths, is negligible within very wide limits, for the albumen remains unaffected where the gelatine would dissolve from its support. Then, again, the albumen surface is so robust even when wet that no care is necessary to prevent abrasion in the several baths, or in the washing waters, and particles of grit do not adhere to its surface as tenaciously as to the gelatine. All these points make for comfort and rapidity in working, especially in hot weather.

A large choice of toning baths await the worker in albumen paper. He may make his bath up and employ it right away, or select a formula which will give a permanent bath, one that can be used over and over again (a supply of gold being added to it after toning operations to retain the original strength). Among the various formulæ for toning baths that exist, the most suitable and certain is the well-known acetate of soda bath. The usual way of using this bath is to make up the bulk and employ this permanently, adding gold and acetate from time to time. Personally, I prefer the method given below, which consists of making up the bath fresh each time from a ripened stock solution, taking just sufficient gold to tone the number of prints in hand, then consigning the used toning bath to the residue tank. The stock solution is:—

Chloride of gold	15 grains.
Acetate of soda	300 ,,
Distilled water	15 ounces.

The gold is dissolved in half the above quantity of water, and neutralised by stirring up with prepared chalk, then filtered into the remaining water, in which the acetate has been dissolved. To prepare the bath for toning, take one ounce of the above and make it up to ten ounces with water; this represents one grain of gold, which is more than sufficient to tone a sheet of paper. If the sensitising bath is kept in good order, and not allowed to become acid, one grain of gold may be safely relied upon to tone one-and-a-half sheets of paper. In winter the temperature of the toning bath should be kept about 70^{0} F., or toning action will be slow and uneven. The tones obtained with the above bath are extremely rich and vary from warm brown to purple, according to the time of immersion, the purple stage being reached in five or six minutes if the paper is working right. On removal from the toning bath, place the prints in a salt bath containing about two ounces of salt to the pint of water; this both stops the toning action and prevents any tendency to blister from placing the print in a fluid of less density.

From this salt bath the prints should go into the fixing bath without any washing. Two fixing baths are desirable, the one containing three ounces of hyposulphite to the pint of water, and the second about half this amount, both being made distinctly alkaline by the addition of either liquor ammoniæ or carbonate of soda. Fixation with two alkaline baths is very thorough, and blisters are quite obviated.

The final washing of albumen prints occupies much less time and water than does gelatine. When one compares the two surfaces it will be readily understood how much easier it is to free an albumen print from hyposulphite than to eliminate it from the gelatine print.

In the albumen print we have a thin, horny film (already coagulated by the silver solution), into which the solutions scarcely penetrate, and from which they are readily washed; on the other hand is an absorbent gelatine surface, from which solutions like hypo are with difficulty discharged by a fluid of less density. It should be borne in mind when leaving albumen prints soaking for any length of time that the albumen surface should be uppermost, as the hypo remains in the paper itself to a far greater extent than in the albumen film, from which it is washed comparatively easily. Drying albumen prints is a simple and expeditious process. They may be taken from the washing water, pressed between blotting-boards, and dried off with heat if wanted hurriedly. There is no gelatine surface to consider at every turn, and to handle as though it were a butterfly's wing. The albumen film is thoroughly good-tempered right through, and seems specially made to withstand rough, unconventional treatment.

It will be readily understood that no exposition of albumen paper printing has been attempted in this article. My aim has been merely to show how simple and reliable a process is open to both amateur and professional, even when their printing is moderate in quantity. Sensitising the paper is simplicity itself, and its keeping qualities when sensitised satisfy all reasonable requirements. Of the quality of an albumen print when carefully produced from good-class negatives I have spoken in last year's ALMANAC. One other point remains to be touched upon, that is, their permanence. Only a short time since I was looking through an album of portraits printed on albumen paper between the years 1855 and '60. These had been toned well into the blue stage, and pasted upon the leaves of the album; yet, in spite of their forty years of life, they bore quite unimportant traces of fading. In my own possession are silver prints done by myself twenty years ago, in amateur days, that would easily pass for last year's prints. From data made at the time I find they were made on bought sensitised paper, toned in a tungstate bath, passed through an acetate of lead bath after fixing, and washed for an hour by hand. They show no signs of fading, in spite of the fact that they have been tossing about loose without any special care.

COLLODIO-CHLORIDE PRINTING-OUT PAPER.

By C. T. SUTTON.

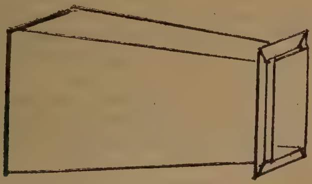
IT is quite a common thing to read in the photographic journals about the difficulties experienced with collodio-chloride paper—that it is hard to manipulate, that very often red marks, lines, and spots are left when the prints are finished, and, of course, this is all put down to the paper, which is immediately classed as no good, whereas about 99 per cent. of these troubles may be traced to careless manipulation, as may be seen by the answers to the queries in the photographic press. Photography is a profession which requires a lot of care to produce good and reliable results, but care is the very thing most ignored by many photographers, who always have dirty hands, dirty dishes, and measures, splash hypo about indiscriminately, tone and fix in the same dish, and then expect to get good results. It should be remembered that collodio-chloride is the printing-out paper which gives the most delicate results when properly finished, and consequently is most likely to show marks of rough and careless usage more quickly than others. Collodio-chloride should not be handled with hot and moist fingers, or the impression of the latter will show in red marks upon the prints, the perspiration preventing the toning bath from acting. A common cause of failure is using a toning bath too strong in gold, whereby nothing but cold slaty-blue tones can be obtained, this, again, being laid to the paper. Collodio-chloride requires very little gold to tone it. A toning bath which answers admirably for P.O.P. or albumen would spoil collodio-chloride. This is generally considered one of its great advantages, as by its use a great saving of gold is effected. Collodio-chloride is very easy to work if handled intelligently and with ordinary care, and no difficulty should be experienced if care and cleanliness are observed.

A USEFUL EXTENSION TO THE CAMERA FOR COPYING PURPOSES.

By J. Pike.

Although the cameras so popular nowadays have, as one of their distinguishing features, an extra length of bellows, they still often fall short of one's requirements. The construction of the camera, also, is not one which admits of much extension at the front, though a cone or tube neatly fitted on a duplicate front will give a useful eight or nine extra inches.

My arrangement is simply a box, tapering slightly, which merely shifts the reversing back of the camera, with focussing screen and appurtenances, an indefinite distance to the rear. Briefly, the back of this box must be made exactly the same size as the back of the camera, with the recess, of course, and buttons for securing the frame when in position. The tapering end is made to fit easily the frame at the back of the camera to which the bellows is attached. It is intended to simply rest in this frame, not to project into the camera to any distance. About a quarter of an inch from this end —the depth of the recess, in fact— a square frame or collar is fixed,



and this, again, is of the size to fit the recess from which we have removed the reversing frame, where it is buttoned, or otherwise held. The frame or collar, if covered all round with a piece of velvet, practically ensures against light entering. The box should now be put in position, and propped up in such a manner as to cause no strain upon the camera, and for this purpose, after careful measurement, strips of wood are fixed as permanent supports.

It is hardly necessary to say that the work should be done neatly and squarely. We do not want any strain upon the camera, nor do we want unduly to overtax the lens, by neglecting to preserve the axial centre.

PRESERVATIVES IN THE DEVELOPER.

By Alex. Snaid.

The amateurs, who really intend to do their best at photography, must always make it a point to themselves make up the developer and other solutions, and when they do this they will soon begin to wonder why the various component chemicals are there. It is not the purpose of this article to deprecate the practice of some button-pressers, who have more money than brains, of buying their solutions ready mixed. It is not for these people that this is written, but for those who really intend to be true photographers, and therefore wish to know the reason and result of everything that they do, and the action of every chemical which they use.

The salts or liquids in a developer have each got some definite work to perform. There is, first of all, the developing agent itself, such as pyrogallic acid, hydroquinone, or metol. Then we have an accelerator to quicken the action of the agent. This will probably be caustic soda or potash, ammonia, or carbonate of sodium or potassium. And, lastly, you will always find a chemical present whose action is to preserve the developer from decomposition. The developing agents when made into solutions are not by any means so stable as when in the solid state, and if no preservative were present they would slowly decompose either by action confined to the simple solution or by contact with the air. This decomposition can be prevented to a very large extent by certain chemical compounds.

The most important one, in general use by almost all workers in one more of their solutions, is sodium sulphite. This is a crystalline salt readily oxidised by exposure to air, the crystals becoming coated with a white powder of sodium sulphate. It should therefore be seen that the sulphite crystals are clean before making up the developer, for if we put in the white coating we are simply adding to the solution a certain amount of useless salt. Another point to bear in mind also, when compounding a developer, is that this salt slows the action of the solution. The result therefore to be aimed at is to get just sufficient in the developer to preserve the latter, and to prevent staining, but not to have any excess. If you have got more sulphite present than is required for prevention of staining you will obtain a thin flat negative with plenty of detail, but no density or contrast. In the case of a pyro developer, the sulphite can be added till its weight is twice that of the pyrogallic acid present. Sulphite can be used with almost every one of the alkaline developers.

Another good preservative is potassium metabisulphite. This is a salt rather shunned by many amateurs, but really it is the best preservative for some of the developing agents. Pyro keeps better with this salt than with sulphite of soda or any other. Theoretically, also, it is far better than sulphite, as in both cases the preserving action is consequent on the presence of a gas known as sulphur dioxide, and the metabisulphite contains twice as much of this gas combined in it as the sulphite. It may therefore be taken as twice as efficient a preservative as sulphite.

As a substitute for metabisulphite when the latter cannot be readily procured, the photographer can take a mixture of sulphite of soda and sulphuric acid, 2½ grains of sulphite being recommended to ½ minim of sulphuric acid. As regards the strength of the metabisulphite as compared with the developing agent, there is a good deal of difference of opinion. With pyrogallic acid you will sometimes see equal quantities of metabisulphite and pyro stated, whilst in other formulæ the proportions will be about one to six. It is advisable, however, to stop at half as much metabisulphite as pyro. This will be quite as strong as will be required for the sake of efficiency as a preservative.

One point to be borne in mind as regards the use of metabisulphite is that this salt is what is known to chemists as an "acid salt," that is, it will neutralise a certain quantity of alkali, and consequently we must remember that part of the sodium carbonate, or whatever alkali we use as the accelerator, will be rendered useless by this metabisulphite instead of doing its duty in the action of development.

This fact also applies to another preservative sometimes recommended—sulphurous acid. This is not an effective compound, and, in the writer's opinion, one not to be recommended. It is well known that sulphurous acid will not keep well, and consequently its action is uncertain. Of course, every one knows that it is simply a solution of sulphur dioxide, and is really no more effective, both theoretically and practically speaking, than its sodium salt, which we have already considered.

The next preservative we will mention is nitric acid. The use of this is not so general as those we first mentioned, and is dying out. It is not an effective preservative, and pyro solutions made up with it soon go brown. Of course, being a ready solvent of metallic silver, it cannot be used to any strength in the developer, which it is supposed to preserve, or it would dissolve the silver as soon as it was deposited, and we should get no image.

Citric acid is sometimes recommended for the duty of keeping the developer in good order. There is no doubt it is a good chemical for removing pyrogallic stains, and it is also a preventative of them to a certain degree, but for a solution which may be kept for a long time it will not preserve the pyro in so good a condition as other chemicals.

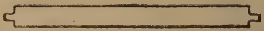
In the use of all preservatives it is a sure plan to dissolve this salt or add the liquid used for this purpose before dissolving the developing agent itself. The solution will then keep good for the maximum period, and, the preservative being first in the field, as it were, has the best chance possible of fulfilling its duty.

PRINT-WASHING APPLIANCE.

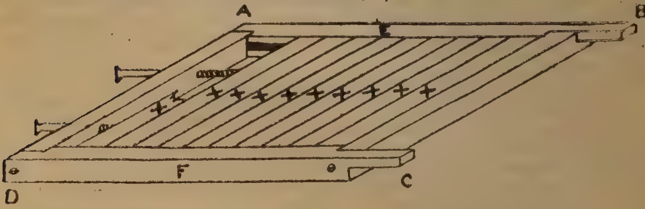
By W. P. Wiseman.

I doubt not there are many readers of The British Journal Almanac who, like myself, have suffered much inconvenience in print-washing from the lack of a regular water supply. All the automatic print-washers on the market that I am acquainted with require running water, in some shape or form, for their effective use, and this is something of a crux where a company's supply is not available. Country workers on a small scale generally revert to the "frequent change" system, and every one whom circumstances have compelled to resort to this plan, knows what a bother it is to manipulate a couple of dozen or so of prints in this way. If they are left alone between the changes they simply lie in a compact mass at the bottom of the water, and little good is done. Frequent stirring is, in some degree, a help, but takes a lot of time, and often results in injury to the prints, and probably throughout the operation some cling persistently together, and thus remain at the end but imperfectly freed from hypo. For efficient washing, the water should have continuous free access to both sides of the print. To ensure this, after trying various other expedients, I constructed the simple piece of apparatus figured above.

Side view of Strips X



Isometrical drawing of frame complete



As the sketch shows, it consists essentially of a square or oblong wooden frame, A, B, C, D. The sides, E F, have grooves cut along their inner edges. In these grooves run a series of narrow wooden strips, the ends of which are tenoned to fit the grooves somewhat loosely. Between these strips the prints are inserted, the waste edges covered by the rebate of the printing frame being utilised for the purpose. When the batch of prints have been inserted, the two brass screws at the left are tightened up, and the whole affair laid on the top of the water in the washing box. Gravity does the rest. If the strips are not made too narrow, the prints quickly fall apart and hang vertically in the water, which gets at every part of their surface. For quarter-plate prints, strips ¼ in. wide would be ample, and for half or whole-plates ⅜ in. If the strips are too narrow the lower edges of the prints are somewhat loth to part. My own frame measures 10 inches long by 8½ inches wide, and accommodates 1½ dozen whole or half-plates, or three dozen quarters. It is well to have the washing vessel sufficiently deep to allow of the prints not reaching the bottom by a couple of inches or so, the hypo contaminated water will thus sink well away.

In the figure, the strip next the screws is broken in half to permit of the groove being seen in side, E. The projecting sides are halved, as shown, in order that the frame may practically float on the surface of the water, and yet, at the same time, rest on the sides of the box. This makes it easier to raise up when the water is changed.

Before being put together permanently, every part should be well varnished, or perhaps what is even better, well soaked in melted paraffin wax. This prevents the sliding parts from jamming owing to the swelling of the wood.

HOME-MADE ISOCHROMATIC SCREENS.

By F. Martin Duncan.

To the query, "Why did you not use some form of isochromatic plate?" I constantly receive the reply, "Because I do not possess a screen; and as I should probably only use an isochromatic plate occasionally, I do not feel inclined to go to the expense of purchasing a set of screens." Now, to the photo-micrographer, a set of screens is almost an absolute necessity, particularly if he aspires to photograph bacteria and the faint markings of diatoms successfully; while those who devote their attention to landscapes and flower studies, would gladly avail themselves of the benefits of the isochromatic plate if they could procure the screens at a cheap rate.

A hint on the production of home-made screens may therefore prove acceptable to many readers of The British Journal Photographic Almanac. Procure half a dozen pieces of "patent" plate glass, 3×3 in. in size, absolutely free from scratches and other blemishes. Place them in a bath composed of concentrated sulphuric acid 6 parts, and potassium bichromate 6 parts, and allow them to soak for some time. Then rinse in running water, and store in alcohol. This will render the plates absolutely clean and free from grease, which is very important, if an even coating of the film is to be obtained; and care should be taken not to handle the cleaned plates more than is absolutely necessary, as wherever the fingers touch the glass is soiled.

Make up an 8 per cent. solution of gelatine and a 2½ per cent. solution of albumen. Take a cleaned plate, and coat it with an even film of albumen, and when that has thoroughly dried pour on sufficient gelatine solution to coat the plate with a thin, even film. While the plates are drying, make up in small quantities one per cent. solutions of methyl-green, acid aniline green, naphthol green, methyl violet, aurantia, and crysoidine; and also a picric acid solution, made by dissolving 20 grains of picric acid to saturation in alcohol, and then adding 2 oz. of distilled water and a few minims of ammonia.

To make a red screen, soak the coated plate in the crysoidine solution; while the green solutions will give screens of various tints of green. The yellow screens, which are in most frequent demand, are made by soaking the plates in the picric acid solution; and a set of several depths of tint should be made. The violet screen is made by soaking the plate in the methyl-violet solution, and the orange screen by using the solution of aurantia.

When the screens are thoroughly dried, the film surface should be protected by a thin cover-glass, such as is used for lantern slides. A collodion emulsion may be used in place of the gelatine-albumen, if preferred.

CARBON PRINTING FOR BEGINNERS.

By Thomas Allison, Wanganui, New Zealand.

While most beginners have no special actinometer for carbon printing, many possess a Watkins's meter. If on exposing the paper from the Watkins's meter it takes six seconds to match the shade, an average negative will print in the same light in six minutes on carbon paper. In New Zealand the carbon paper is made with hard gelatine, so that in England the time would be a little shorter, but one or two trials would give the proportion. Of course, after selecting what you consider an average density negative for a standard, you must classify the negatives from which you are printing as being more or less dense, and expose accordingly. This can either be guessed at, or the actual proportionate density can be easily found by the ingenious apparatus described by Mr. Babbage in last year's Almanac.

A WRINKLE WORTH CONSIDERATION.

By A. L. Henderson.

On opening a box of varnished negatives taken about twelve years ago I came across a few marked all over with the usual characteristic red spots, caused by the contact with the sensitive paper. The said negatives were not spotty when packed away. So I argued with myself thus, that the spots were not metallic silver reduced by light; and, if so, there should be no great difficulty in removing them. I proceeded to experiment as follows:—I placed the negative in a solution of potassium iodide (common salt will do as well) for a few minutes, then rinsed and immersed in a new solution of hyposulphite of soda. Lo, presto! the trick was done. Another plate from the same batch which lay about in the light for several days refused to be treated successfully. Of course, the reader will understand that the doctored negative will require the usual washing, and when dry might require revarnishing, and it is advisable to remove all the old varnish. but in no instance should the varnish be removed before treating the negative with salt and hypo. It is very difficult for me to follow up these experiments for want of spotty negatives, not darkened by exposure. Should any further light be shown on the matter during the ensuing year you may hear of it.

A SIMPLE SIX-CHAMBERED POCKET CAMERA.

By G. F. Ashley.

Nowadays, the would-be amateur of an economical turn of mind cannot plead expense as an excuse for not taking up the delightful art of picture-making, for one can buy a camera for very little, and the plates or films, the necessary chemicals and appliances to complete the outfit can only add a trifle. But, if he be of a practical turn of mind, it will add to the interest and novelty of the hobby to make his own camera, and that, as will be presently shown, can be done for next to nothing, and prove besides very economical in use.

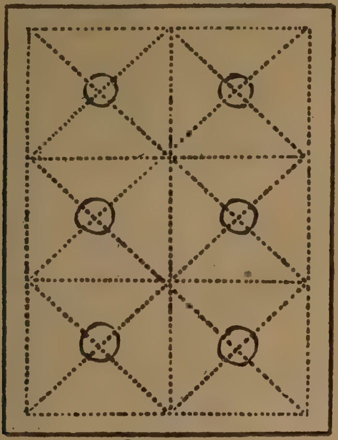


Fig 1

Six different pictures can be taken on one plate, side by side. one at a time, and the camera can be conveniently carried in an ordinary pocket. Pinholes are used in this case in substitution for lenses, and they will be found to answer for small pictures, with a normal exposure. To start with, get an empty dry plate box (quarter size), one consisting of a lid and bottom part. Some dull black card, of the thickness and quality of a visiting card, some ordinary cardboard similar to that of the box, and a glue-pot. Remove the lid of the box, which is to serve as the front of the camera, and draw on the outside of it six rectangles (1⅜ inches in height and 1½ inches in width (fig. 1). This will leave a narrow surrounding margin. Then draw diagonals from corner to corner of each rectangle. At the centre of each rectangle, and at the intersection of the diagonals, punch a clean hole ⅜ in. in diameter. Glue strips ⅝ in. in width of the thicker cardboard **on each side** of the inside of the lid, and another strip ⅞ in. in width in the centre, so as to leave grooves for the shutters to work over the punched holes (fig. 2). The shutters should be cut from

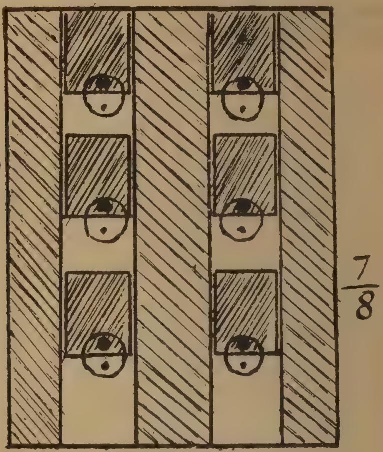


Fig 2.

the thin black cardboard in rectangles ⅞ in. × ⅝ in. Two pieces of this size will be required for each shutter. In one of the pieces a brass piercer fastened should be inserted at ⅛ in. from one end, and the legs of the fastener bent backwards, so that the second piece of cardboard can be glued to the first piece. The head of the fastener will serve as a button to manipulate the shutter. (See figs. 3 and 4.) The shutters, when firm and dry, may be laid in the grooves with the buttonheads protruding through the ⅜ in. punched holes. (See fig. 2.)

The next part to make will be the pin-hole card. Cut a piece of the thin black cardboard to fill the inside of the lid. Divide it in the same way as the lid front into six rectangles, with diagonals only ⅛ in.

lower down. This will leave more margin at the top and less at the bottom. Place it inside the lid after sliding the shutters forward to open. The rectangle centres should fall about $\frac{1}{8}$ in. from the lower edge of the large punched holes. (See fig. 2.) After fitting accurately, the pin-holes should be made by carefully punching or perforating tiny clean holes about 1-64th in. in diameter, at the intersection points or rectangle centres. In the absence of proper tools a fine needle may be used, but so as to leave a clean unfrayed edge.

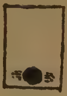


Fig 3 Front View

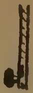


Fig 4 Side View

A second card should now be marked out like the last, but in place of the pin-holes small windows one-fourth the size of the rectangles should be cut by means of a ruler and sharp penknife. These must be cut out very carefully, and should correspond with the pin-hole card, so that the pin-holes fall respectively in the centre of each

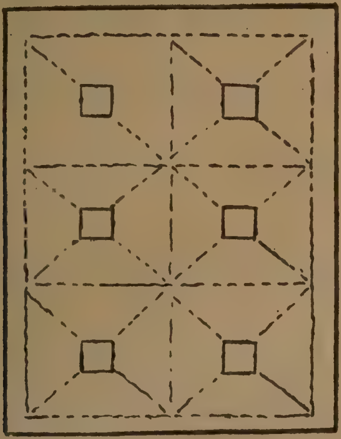


Fig 5.

window. The windows serve to limit the size of the pictures to the space intended for each on the plate. The size of each window will be 5-16 in. × ⅜ in. (See fig. 5.)

Window-card supports exactly ¼ in. in height should be cut from the thick cardboard to just fit the inside of the box, and an extra piece for the centre. These serve to separate the pin-hole card from the window-card by exactly ¼ in.

The above parts may now be fitted together—the pin-hole card glued to the bottom part of the lid, with the rough edges of the pin-holes (if any) inwards. This should fit so as to allow the shutters to shoot forwards and backwards to cover or uncover each pin-hole as required—without their being too free or too tight—then glue the ¼ in. separating supports, and finally the window-card. These complete the front portion.

The bottom part of the box can now be taken in hand. This will serve as the plate-holder. The bottom and sides should be lined with the thin black card. To make the plate fit properly a thicker piece of cardboard, or wood, may have to be glued at one or both ends. The plate should fit nicely, so that when the box is tilted it will just fall out. To provide means for holding it, glue a piece of cardboard at one end of the box, so as to overlap the edge of the plate. At the other end a simple swing catch can be fitted to pivot on a small screw or rivet. When fitted together the box should be absolutely light-tight. Any good brand (quarter-plate size) of plate, special rapid speed, may be used.

The distance from the object should be about the same as its size, but the camera will be found particularly suitable for small and near subjects with plenty of contrast, and as far as possible in the same plane.

Exposure (outside)	Very bright days ...	1 to 5 seconds	according to subject.
	Average, with cloud,	2 ,, 10 ,,	
	Dull days	4 ,, 20 ,,	

FRAME FOR SHOWING TRANSPARENCIES.

By J. Tilfor.

I contributed an article to last year's Almanac on the production of transparencies by a dry collodion process. I now send the description of a frame for showing them. Mine is made for whole plates, but it can, of course, be constructed for any size. The frame is somewhat of the shape of a retouching desk, with the back and sides enclosed by glass, and the bottom lined with white card. There is a rabbet in front for the reception of the transparency, which is backed by a plate of finely ground glass, and kept in its place by a thin frame sliding in grooves. This frame is reversible, so that pictures taken either way on the plate can be shown. In the base is a grooved receptacle, with a flap front, secured by a spring catch, for a reserve of transparencies. Mine holds eighteen.

A MODIFIED SENSITOMETER.

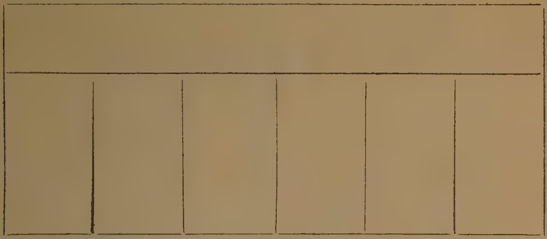
By Arthur Payne, F.C.S.

The two chief difficulties which are met with in adjusting an Abney's sensitometer are the measuring of the luminosities of the colours in the photometer and the equalising of these luminosities by various means, which have been specified by Sir William Abney in his valuable papers.

A simple form of sensitometer may readily be made, without any special apparatus, by using the camera as a photometer, and equalising the luminosities of the colours by bands of pure white tissue paper.

Procure six pieces of coloured glass or dyed films—pink, red, yellow, green, green-blue, and blue—each piece measuring one inch by three inches, one piece of clean glass or film, six inches long by one inch wide, and a piece of fine ground glass six inches by four inches.

Mount the coloured glasses and the strip of clear glass upon the ground glass by means of strips of paper.



Procure a wooden box about ten inches long, eight inches wide, and four inches deep; cut a square opening at the bottom the size requisite to hold the rough sensitometer. This box must be painted all over inside with dead black paint, and when it is dry the sensitometer is fixed in the opening, with the ground glass towards the inside of the box. Erect this in front of a camera which is fitted with a lens possessing an iris diaphragm capable of working at f-64. Focus the glasses carefully, and then cover the intervening space between the camera and the box, at the top and sides but not the bottom, with some arrangement in order to cut off all extraneous light. A focussing cloth will answer the purpose. Under another focussing cloth carefully examine the image at the back of the camera, open the lens to f-8, and then, whilst examining the image, slowly reduce the aperture to f-64. The various colours will disappear one after the other as the aperture gets smaller, until only the brightest colours are visible. The luminosities of these colours are then reduced by fastening strips of thin white tissue paper over the brightest, by means of paste, which is used only on the ends of the strips. The sensitometer is carefully adjusted in this manner, until the whole of the colours, including the clear or white glass, appear to be of equal luminosity.

When this has been satisfactorily accomplished the sensitometer is ready for use, but, like all similar appliances, only with the same quality of light with which it has been adjusted.

The method herein employed of using the camera as a photometer may prove of service when engaged in adjusting an Abney's whirler sensitometer.

UNIFORMITY AND SIMPLICITY IN DEVELOPMENT.

By J. J. S. Bird, B.A.

Development is not the most pleasant part of photographic work, though even that has its charms. The "waiting for the result" and the excitement of seeing "what we shall get," when an important exposure is under manipulation, make up for the weariness of the somewhat tedious process.

To read all the different formulæ published by different plate-makers almost makes one shiver. It would give the impression that the world itself cannot equal the complication of means to effect one common end which photography affords. And yet if we examine these different formulæ with care we find that they are all practically the same. I have always grudged the space given at the end of the Almanac to the formulæ of the different manufacturers. It is the biggest farce in the world to say that any manufacturers' plates develop best with the particular developer they recommend. As a matter of fact, the statement is in many cases incorrect, and I say this with the experience of 45 years to back me up in the development of collodion and gelatine plates. The variation of a quarter of a grain of any individual item in the compounding of a formula is given by a merciful and generous Editor best part of a valuable page, and is absolutely immaterial in results.

Why there is not a uniform formula with slight variations suggested according to the plate must, however, remain for the present one of the unsolved examples of the "cussedness" of human inconsistencies. But the desired consummation is drawing nearer to its accomplishment; there are promising signs of improvement.

Now, I suggest one great step, like other great things, the essence of simplicity—I call it the great standard accelerator. It is nothing new. Almost all formulæ contain it in one form or another, with the paltry variations of nomenclature, or quantity, or dilution. One maker will tell you to mix 17 oz., another 30, and work out all the other proportions of ingredients to make out that his receipt is different to others, in form and appearance only, but identical in composition. My unity is one. To make such a solution take:—

Water	1 pint
Sod. carb.	1 oz.
Sod. sulph.	1 oz.
Potas. brom.	1 scruple

The above is suitable for three-quarters of modern developers—pyro, metol, glycin, ortol, quinol.

For developing with pyro take, say, 2 oz. of the solution and add a small mustard-spoonful of dry pyro. I never could conceive the good of mixing up a separate solution of pyro. In nearly every formula an acid is added to the solution to preserve the salt from deterioration. What is the result? An effervescence takes place when the alkali is added, and tiny bubbles keep on settling on the surface of the plate, which no rocking can remove. To brush them off scratches the surface of the film. Besides, it is so very easy to judge of 2 or 4 grains of pyro after a few trials.

For ortol take 1 oz. of this standard solution and add 1 oz. of the accepted ortol formula, viz.,

Water	1 pint
Ortol	2 drachms
Metabisulphite of soda	1 drachm

This solution will keep good for years. I am not going to take up space in working out the other developers. With these two splendid ones, pyro and ortol, I believe that any man with common sense can perfectly develop any plate on the market. Yea, more, the ortol will develop any bromide paper commercially sold, and gives splendid tones with velox and other gaslight papers. But for some purposes a solution of 2 drachms of hydroquinone to the pint of water comes in useful. If metol and quinol together are desired, my readers can easily work out the quantity required; but I fight shy of metol because it won't keep, and it stings the fingers.

Let us hope that the time will come soon when some such simple accelerator will be the standard, and the other portions of the various developers will be worked out, so that 1 oz. each of the two solutions will be all that has to be taken. What a saving of printers' ink it will effect; what a relief from the weariness of inane repetitions will be removed from this most valuable annual.

A NOTE ON SHORTENING THE FOCUS OF THE COOKE LENS.

By John A. Hodges.

Those readers of the Almanac who may happen to possess a Cooke anastigmat may be interested in knowing that by a very simple expedient the normal focus of the lens, as issued by the makers, can be considerably shortened. Some 12 months or so ago I found out, quite by accident, when experimenting with my own Cooke triplet, that by slightly unscrewing its anterior or front combination, and thereby increasing the distance between it and the central bi-concave element, the focal length was appreciably reduced. Further experiment proved quite clearly that a considerable diminution of focal length might in this way be effected without impairing the optical quality of the image to an offensive degree. The focus of my own lens is 5.5 in., and I find that by unscrewing the front combination to the extent of about one half-turn the focus is thereby reduced to about 5 in. One complete revolution, or a trifle more, will reduce the focal length to approximately 4½ in. A greater degree of separation will still further shorten the focus, but in practice it will be found inadvisable to exceed the amount stated, or astigmatism and other aberrations will be introduced to an extent which will seriously interfere with the optical quality of the image. It will, of course, be obvious that with the focal length of the lens shortened in this way the apertures as marked upon the iris scale will no longer be accurate, and in testing the definition, covering power, etc., due allowance must be made for this fact. With regard to the performance of the lens when used in the manner indicated, I find that when its focal length is reduced to 4½ in. an aperture of *f* 22 gives sufficiently sharp definition over the whole of a quarter-plate for all practical purposes.

The utility of such an expedient is, of course, apparent, for the possessor of a 5 in. lens can immediately, and by the simplest means imaginable, convert it into one giving a considerably wider angle; a not inconsiderable advantage to that large class of workers who own but one lens, and endeavour, it must be confessed sometimes with very ill-success, to do all their work with it.

PHOTOGRAPHING FUNGOID GROWTHS.

By W. H. Walmsley.

In the search of new food for the camera, a very rich and fruitful field, capable of yielding sustenance for the camerist as well, seems to have been almost completely overlooked. I refer to the fungoid flora with which our forests, moorlands, and meadows are so plentifully stocked from early spring until late in the autumn. The mushrooms (or toadstools, as you will) are so beautiful in form and colour, of such infinite variety, and mostly of such delicious succulence, that they would seem to invite the closest attention for both artistic and gastronomic reasons. The finding in their habitats calls for exercise in the open air, the cultivation of a habit of close observation, and the revealing of new beauties to which we were hitherto strangers. And as one can scarcely fail to make a habit of systematically studying the different species while photographing them, he would doubtless in a single season's work be able to distinguish most of the edible and wholesome forms from the poisonous or deleterious, which latter, fortunately, comprise but a small percentage of the vast number of species.

It is the photographic side of the subject, however, with which this article has to deal, and a brief résumé of my methods of work may possibly prove interesting. For some years my summers have been spent in the mountainous region of West Virginia, a locality particularly rich and varied in its fungoid flora, toward which my attention was almost unconsciously directed during daily tramps in the woods. At first my attempts were confined to photographing the most striking forms as they grew in their native haunts, but this was found to be unsatisfactory for many reasons—uncertain lighting, improper backgrounds, etc. The following season, therefore, found me prepared to do the photographic work in my room at the hotel. The arrangements were very simple. In front of a window with northern exposure and French sash, which could be opened wide from top to bottom, a table some three feet in length was placed, its inner end carrying the subject, faced by the camera at the other, so that the light entering by the open window fell fully upon the specimen in front of the lens, illuminating it evenly and perfectly. Two backgrounds only were used, one of black velvet, the other a large cardboard, with pure white matt surface. These were attached to a light tripod stand, which could be placed in position at a moment's notice. The camera was a Beck's quarter-plate, with rising and fall-

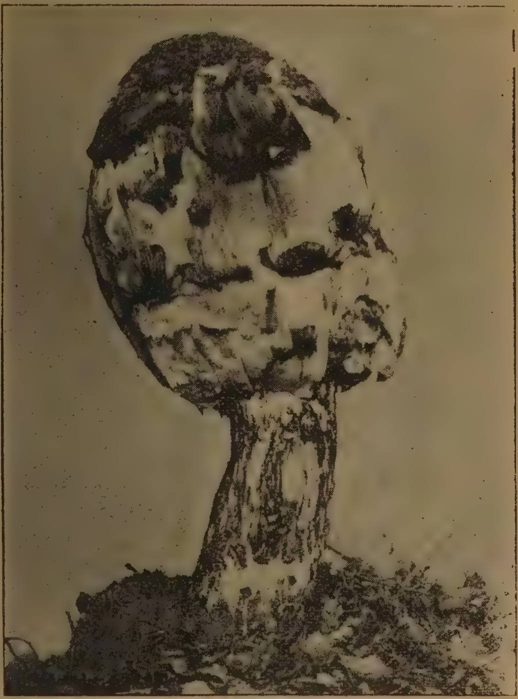


Fig. 1.—Coprinus Comatus.

ing front, reversible back, and ten inches bellows extension, fitted with one of their 5 in. rapid rectilinear lenses (occasionally a wide-angle 3 in. was used). The camera was mounted on a platform the size of its baseboard, and fitted with three feet, so that it always stood firmly upon the table top, and could be moved in any direction with the greatest facility. Orthochromatic plates were used exclusively, with home-made colour screens. The latter were placed in front of the lens, being carried in a light but steady frame, which could be moved about at will. Most of the exposures were made at f-22, but occasionally f-32 was used. With this simple apparatus about 150 photographs were made during the past summer—all good, not one failure. For the first time, also, they were developed as made, and not stored away for development during the coming

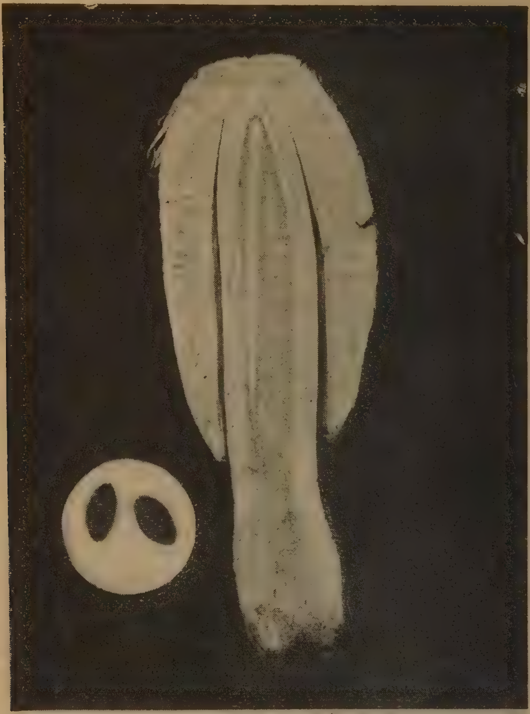


Fig. 2.—Coprinus Comatus (long section). Spores of same+500.

winter, as was formerly my habit, and I think the new departure a good one. A few light rubber trays, developers in powdered form, a bottle of acid hypo, a drying rack, a graduate and portable dark-room lantern, made up the necessary outfit.

My collecting tramps were made early in the day after a cup of coffee and roll, which served for several hours of mountain walking and climbing that brought on a rousing appetite for the midday déjeuner. A basket and garden trowel, with some paper bags, not forgetting my trusty staff, useful alike in rough paths or where there were none at all, and as a snake destroyer, comprised the necessary collecting outfit. All specimens were carefully gathered so as to preserve the entire stem, with bulb (if the latter existed), and the

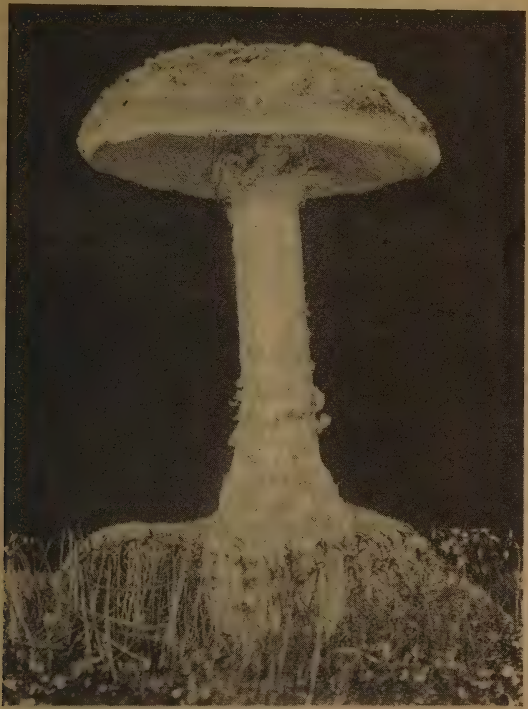


Fig. 3.—Amanita Strobiliformis

mycelium. Each was placed in one of the bags, with careful notes of its habitat, mode of growth, colour, size. Whenever possible, each fungus was photographed at several periods of its growth, from the little "mobbin" just out of the ground to the mature plant, with surface of pileus and gills beneath as well, and usually upon one plate. Spore prints were also made by cutting the stems off close to the caps and placing the latter, gills downward, upon a sheet of paper, carefully noting the colour of spores in mass—a most important factor in identifying species. Photomicrographs of the individual spores were also made, always under an amplification of 500 diameters, which, being printed with the mushroom negative, made very interesting and valuable pictures. For exposing, the fungi were planted in, or rather on top of, a sod, bunch of moss, or earth as suited to their habitats, being held in position by that most useful article, a lady's hairpin, so inserted as to be invisible. In this way every portion of the plant from bulb to pileus was fully shown in natural position as growing.

Photographs of mushrooms, especially if coloured after nature, make most interesting, instructive, and beautiful lantern slides, always popular and highly appreciated by the most cultivated and intelligent audiences. The prints are eagerly sought for by teachers of botany everywhere. In short, here is a field worth cultivating by any photographer in the search for fresh subjects. And, after being "took," they can be eaten with great satisfaction—if they be of the right sort. But make sure of that first. It is not recommended that the old recipe for finding out be followed, namely, "Cook and eat them: if you survive, they are mushrooms; if they kill—toadstools."

The accompanying illustrations serve to show the character of this work, and the adaptability of the white and black backgrounds to the varying colours of the subjects, which, it may be remarked, are all made on a scale of about two-thirds natural sizes.

Fig. 1 is a mature plant of Coprinus Comatus, or Horsetail Mushroom, a very handsome plant, and a prime favourite for the table. Fig. 2 shows a longitudinal of a younger plant of the same species; also two of its black spores magnified 500 diameters. Fig. 3 is the beautiful and stately Amanita strobiliformis, which, though a member of the family containing the most deadly of poisonous fungi, is itself wholesome and most delicious; quite as good in a gastronomic as an æsthetic point of view.

DAYLIGHT ENLARGING IN COMFORT.

By Charles Louis Hett.

If an enlarger is to be of real service to the amateur it should always be ready for use, and not stowed away on a top shelf. Perhaps my experience in arranging my enlarger may be of interest to other amateurs. Mine is a Koresco of the smallest size. This is quite sufficient for most work. It is well made; but the first thing to do is to take out the lens supplied with it, and fit your own lens to it. The one I use is a Cooke 5½ in. focus; but a shorter focus is better if you wish to enlarge to the utmost capacity of the Koresco.

The mode of fixing is the next point. For general convenience the horizontal position is the best. I have a strong swing arm, terminating in a table about 12 in. in diameter. This table carries the stand of an old reflecting telescope, to which the enlarger is attached by two centre screws. Thus the Koresco can be swung up to the window for use, or back out of the way when not required. The lighting is accomplished by means of a reflector. That, which I used at first, was of the usual type described in manuals. But this was not satisfactory when a wet day came and I thought of enlarging; the window and reflector were both very dirty, and my enlargements had several markings in addition to the picture on the negative. Cleaning the window was not a serious matter, but the opal reflector was more difficult—ammonia, soda, and bath brick each had its turn. But the cleansing occupation was hardly such as one would select as being the most suitable for a cold wet day. I now have an ever-ready reflector which does not get soiled to any extent; and which can be sponged from the inside. A pane 14½ in. by 11 in. was removed from the window and the opal reflector fixed outside at flatter angle than the 45 deg. advised in text books. This opal was 2 ft. long by 18 in. wide; but the width was reduced at the end next the window to 10½ in., in order that its frame might be screwed to the vertical sash bars. The framing is carried up two panes deep and glazed with clear glass both at the sides and on the top. The roof has a fall outwards of some 14 in. Now, I have no difficulty in obtaining enlargements free from unwelcome additions.

A SIMPLE PHOTOMETER.

By F. S. N. Macrory.

It may be useful to a large number of photographers to know of a simple and efficient means of measuring the relative intensities of different illuminants. The method is an old one, having been devised by Bunsen, but it is not very generally known.

The only apparatus necessary are a sheet of paper (brown or greenish tints are preferable to white) and a small quantity of vaseline or other grease. Cut out a rough square of your paper, and make a grease spot in the centre of it. Now, if a lighted candle be placed at one side of the paper and the paper looked at from the other side, the grease spot will appear as a shining mark on the paper, whereas if it is viewed from the same side as the candle, it will appear as a dark mark. If a lighted candle be placed on each side of the paper, and if the illuminating power and distance from the paper of each candle are equal, the grease spot will have the same appearance from each side of the paper. If one candle be now moved further from the paper, the grease spot on that side will become bright, while on the opposite side it will seem dark. Now a simple physical rule tells us that the intensity of light varies as the square of the distance. So if we have adjusted our two candles to such distances on either side of the paper that the grease spot appears similar from either side, and if we then find that the distance of one candle is, say, twice that of the other from the paper, it follows that the illuminating power of the former is $(2)^2=4$ times that of the latter. A very simple arrangement can thus be readily constructed to measure the relative intensities of any two illuminants, e.g., a candle and a gas flame, etc., etc. The experiment should be done in a room lighted only by the two illuminants to be tested. This idea may be of service to bromide printers, etc.

ABOUT COLLODION EMULSION.

By A. V. Kenah.

It seems quite out of place nowadays for any one to recommend photographers, especially amateurs, to attempt to work with anything but the gelatine dry plate, and yet there are many advantages to be obtained from the use of collodion emulsion which cannot be got from the popular gelatine dry plate. The mere mention of anything in the shape of collodion is enough to give most photographers horrible visions of such troublesome things as the silver bath, but this is only the result of ignorance on their part, as the manipulation of collodion emulsion is very simple. Let me give you some of the advantages which can be claimed for collodion emulsion:—

(1) Any size work may be done without having to lay in a stock of different sized plates.

(2) The pictures may be dried with a degree of rapidity unknown to the gelatine worker by the application of heat.

(3) Its cheapness

(4) Its excellent keeping qualities.

(5) The picture can be developed on the hand without the use of dishes.

(6) Its utility for every branch of photographic work.

(7) The magnificence of the results.

These points occur to me at the time of writing, but there are other many equally excellent qualities which become apparent to the worker. But I will deal with the above. (1) Any size work may be done. This is obvious, as it is only necesary to take a sheet of glass of the size required, and coat it with the emulsion by merely pouring it over it. (2) By holding the picture to the fire it may be dried in a few moments. (3) Its cheapness. This is at once apparent when one compares the price of the emulsion, as sold, with the prices of gelatine dry plates; and, in the case of three-colour work, the difference in price is amazing; for instance, one dozen 8×12 plates coated with a perfect emulsion for three-colour work costs under 2s., while panchromatic plates this size are about five times as costly. (4) Collodion emulsion keeps indefinitely. (5) The facility of developing on the hand has to be tried to be appreciated, and gives the operator a considerably greater control than when having to use dishes. (6) Here we have one of the greatest advantages of collodion emulsion. It does equally well for studio work or for process work. The exposures are about the same as for ordinary dry gelatine plates, and by using it we retain the beautiful softness, with detail in the high lights, which characterises collodion work, and which is so rarely got with gelatine plates. For lantern slides it is most excellent, beautiful results being attainable, while the slide can be easily toned if preferred.

For three-colour work collodion emulsion opens up a fine field to the worker, as collodion is well known to be much more suitable for staining with aniline dyes than gelatine on account of it not staining the film to that extent in which it acts as a filter. The consequence is that the absorption bands are much more sharply defined when using collodion emulsion than when employing gelatine. For three-colour work the emulsion is rendered colour-sensitive by the addition of certain aniline dyes used as alcoholic solutions, and applied either by mixing with the collodion emulsion or else by pouring over the coated plate. Great strides have recently been made in this important branch of work, and the exposures have been brought down to a very practical working point. To give an example: In making a trichromatic set of negatives of a colour print, the exposure for the yellow printing negative was 10 seconds, for the red printing negative 10 seconds, and for the blue printing negative 40 seconds. The lens used was a Cooke "process" at f-8, the image being slightly reduced, and the illumination consisting of two "Penrose" arc lamps of 2500 candle-power, 25 ampères each, with parabolic reflectors.

To the practical colour worker this is good news, as the cost of production is low, and the results can be so very quickly obtained.

The emulsion which should be used is that sold by Messrs. Penrose and Co., 109, Farringdon-road, E.C.

This is most carefully prepared, and is ready for immediate use, and is sent out with full instructions, which, if followed, must prove an easy and sure road to success. These few and necessarily incomplete remarks may, I trust, ensure some other photographers becoming workers in this elegant process.

CARBONATE OF SODA.

By T. W DERRINGTON.

A VERY pure carbonate of soda for photographic purposes (developing, etc.) can be made by heating the ordinary bicarbonate of soda to a dull red heat. Water and carbon dioxide are given off, and dry carbonate left behind. The chemical action which takes place is represented by the equation:—

$$2NaHCO_3 = Na_2CO_3 + H_2O + CO_2.$$

The heating is best done in a platinum dish; failing that, a nickel one will do very well, or, last of all, an iron one. The latter one is liable to oxidise at the temperature necessary. The powdered bicarbonate is heated till no more gas is given off, which is easily seen as it makes miniature craters in the powder while it is coming off. It should be kept stirred with a glass rod all the time, and, when finished, allowed to cool, and placed immediately in a well-corked or stoppered bottle. Porcelain dishes will not do for the purpose, as the carbonate would attack them and spoil both.

I find on analysis that the carbonate of soda made in this way contains 99.9 per cent. of pure salt, a purity amply sufficient for all photographic purposes. A great advantage of the dry salt is that in dissolving in water heat is developed, so that it dissolves very rapidly; the crystalline salt absorbs heat in dissolving.

From the equation given above, it will be seen that 168 parts of bicarbonate will leave 106 parts of carbonate of soda. Roughly, it may be reckoned that from each pound of bicarbonate 10 ozs. of carbonate will be obtained.

CARBON PRINTING.

By E. J. Steer, Capetown.

In the text-books on carbon printing we are told that the development of the tissue is rapidly effected, and is largely under control of the operator by the use of a stream of water at the required temperature. Amateurs who have not the convenience of a supply of hot water laid on to the work-room may obtain the same result by adopting the following simple method, which I find in practice exceedingly effective.

Having mounted the exposed tissue and stripped off the backing secundum artem, I take a jug holding about a quart, and pour the hot water in the developing tank into the jug. Then, holding the jug over the tank at such a height as to get the required force, I pour the hot water in a gentle stream over the print. Repeat this for two or three times; then, if more reduction is required, add boiling water to the water in the jug to the required temperature, hold the jug a little higher above the developing tank, and the desired reduction is quickly effected. Local treatment by this method is rendered rapid and certain, and I find that I can easily develop a dozen 9×7 prints in this manner in less than an hour.

With regard to the keeping qualities of carbon tissue, I am now using some tissue I imported from the Autotype Co. two years ago, and it is perfectly soluble and satisfactory in every way.

To get a fine matt surface on a print mounted on the final support by double transfer, I remove the wax from the surface of the print in the usual way with rectified spirit, allow to dry, and soak in water for a few minutes. Then squeegee the print on to a ground opal plate which has been previously talced and polished. When dry the print will leave the ground glass surface with a very fine matt finish.

DISSOLVED PROBLEMS.

By J. Dormer.

"Something practical," lithographs the Editor; which, being interpreted means an experience from which £ s. d. may be crystallised. This suggests solutions, and, further, the comparative cost of developers.

But to speak off-hand concerning the comparative cost of developers is to ignore their diversity of structure. Formulists reveal an admirable breadth of mind. They are not hide-bound by rigidity of rules. If in one case a hydroquinone formula works out at four fluid ounces per penny, another, equally normal, yields 35 for the same coin, so that economically disposed persons may be suited. Obviously, then, the cost must be of averages or types (such as scheduled from the German in last year's Almanac). But the cost of the typical formula does not suit those who don't happen to use it; and, moreover, there is to be considered the how, the when, and the where of price of the ingredients, to which the law of the Medes and the Persians does not appear applicable. Pyro bought by the ton is probably cheaper than when bought by the bottleful. Unfortunately, I do not buy it by the ton myself. It is said, too, that when a man visits the stores to invest in an ounce of hypo, Mark Twain's advice is likely to come in handy. "When," he says, "the man asks you which you want, troy or avoirdupois, it is best to say 'Yes,' and shift the subject." And, after all, hypo is more satisfactory outside the developer, as a rule.

By the aid of the integral calculus and quaternions, and so on, the following figures were arrived at as fairly representing the amount per penny of some normal developers used:—

Pyro-soda	7 to 10 oz. fl.
Pyro-potash	8 to 13 ,,
Pyro-ammonia	16 to 22 ,,
Pyro-acetone	4 to 5 ,,
Hydroquinone	7 to 16 ,,
Hydroquinone-metol	about 7 ,,
Metol	4 to 6 ,,
Amidol	about 6 ,,
Eikonogen	about 4 ,,
Ferrous oxalate	about 9 ,,

The more recent developers usually yield about 5 or 6 fl. oz. per penny, though, of course, no comparison can be made as to the number of plates developable per oz., or as to other factors which influence real cost. But the figures serve to give a rough idea of the subject, and indicate why pyro has not yet been dethroned.

To balance these dutifully practical remarks, one may conclude with an observation on the behaviour of some similar solutions. A few years ago an interesting paper was read before the Royal Photographic Society on the dialysis of certain photographic salts through gelatine septa. The author of this paper used 10 per cent. solutions of hypo (crystals), sodium sulphite (crystals), and carbonate (crystals), and potassium bromide; together with 7 per cent. mercury bichloride and 2 per cent. pyro solutions. Though taking many precautions to ensure as much uniformity as possible, no allowance was apparently made for the water of crystallisation where present. Deducting this would make the strength of the above solutions as follows:—Pyro 2 per cent., carbonate 3.7 per cent., sulphite 5 per cent., hypo 6.4 per cent., mercury 7 per cent., and bromide 10 per cent. The point to be observed is that the percentages which passed through plain gelatine septa increased in the above order, save in the case of sulphite. Chrome alumed septa favoured pyro; and oxidised-pyro septa hypo, but otherwise a similar state of affairs obtained. This seems to point to the influence of the "real" strength of the solutions on the results, which would thus be somewhat disguised. Finally, with regard to the rapider dialysis of the sulphite, it so happens that the molecular weight of this article, like those of pyro and ferrous oxalate, is an integral multiple of that of water. One would like to generalise and dogmatise on rapidity of development being favoured by the use of developers whose molecular weights are n times 18, n being an integer. But both generalisations and mathematics are terrible to a photographer.

ON THE NEGLECT OF INTENSIFICATION BY AMATEURS.

By H. J. Channon.

According to my experience, the most serious of the technical faults of the photographic amateurs of the present day seems to be a terrible flatness in all their work, resulting from insufficient density in their negatives. On looking over the productions of friends suffering from photographic mania, after paying the usual and necessary compliments, I find myself nearly always impelled to ask the question: "Do you never intensify your negatives?" It is an almost invariable rule that the work shows great need of such treatment, and, it may be well to add, the friends I am referring to are not among those who adopt this style of production intentionally and on high art principles; they would be very pleased to turn out bright and pleasing pictures. The answer generally given is that they do not know how to intensify, with a hint that it is cruel to wish to inflict upon them the labour of studying so abstruse and mysterious a subject as is involved in that process. Why they should regard what is really a perfectly simple process as lying altogether beyond their capabilities is difficult to understand, but it is certainly the fact that my advice to sometimes resort to intensification has not once been adopted. Nevertheless, I venture to repeat the advice in the pages of this Almanac, where I feel sure it will come under the notice of many amateurs who are in need of it. In the impatience to get out of the dark room and examine the fruits of our labours, many underdeveloped and disappointing negatives are turned out, which only require a little added density to render them altogether delightful.

Naturally, we could only expect the class of workers indicated to adopt the simplest of intensifying processes, and that would, almost certainly, involve the use of solutions containing mercurial salts. As those I have in view are likely to be inexperienced in chemical matters, it is, therefore, perhaps advisable to add the caution that much care should be taken in the use and storage of these chemicals, the salts of mercury being virulent poisons.

A REMEDY FOR METALLIC SPOTS ON NEGATIVES.

By G. H. Allen.

Being continually developing in a large way, I have no doubt the following will interest your many readers, and I hope, what is more, will be to their good, especially if they will give it a fair trial. Very often of late years, when I have had occasion to mix a fresh fixing bath (for negatives), it has been my ill-fortune to find, when taking the negatives (that are fixed first) from the bath, to be completely covered with small violet spots (and which, of course, must happen to be on a special order), therefore causing great irritation of mind.

Now, being confronted with these disasters more than often, it scarcely needs my divulging the fact that I have tried nearly, if not all, remedies. But none I cannot say with better results than the following:—

Citric acid	½ ounce.
Water	3 ounces.

When dissolved, flow some of the above over the negatives, allowing it to remain in same for about half a minute, after which remove it (without washing), and again immerse in fixing bath for two or three minutes, when the result should be more than gratifying. Should the above find acceptance to the readers, I shall feel my time has not been wasted.

A RELIABLE DEVELOPER.

By William Brooks.

A question often asked by amateurs is: Which is the best developer to use, one that does not blacken the hands? This question is a very pertinent one to those who take up photography as a pastime, and do not like to be seen as if they had been pickling walnuts; this kind of thing would not do for such as clergymen, doctors, dentists, etc. In the days of the wet plate one could not help getting stained. Now, in the days of dry plates, with pyro development, there is still a certain amount of staining. Professional photographers have looked upon pyro as their sheet anchor for the past fifty years, and they do not like to part with an old friend. With the advent of all the new developers, matters have somewhat changed, and one does not like to stand still. I have given most of the developers a fair trial, not just merely by trying two or three plates, but with many dozens, and have been able to compare one developer with another. I have found that some have special advantages, and also disadvantages. as one might expect. Hydroquinone does very well for black and white, but as an all-round developer I found that it did not do. Metol is a very dangerous developer to use, as it attacks the hands of most people. I can speak from experience, and I think it had better be left alone. The developer that I have found give the best results is Glycin, it possesses a great many advantages, and very few disadvantages. One great advantage is, that it responds very readily to the use of bromide as a restrainer, far more than pyro. With a one solution concentrated developer, almost any class of work can be done with it. My experience extends with it for over five years; made up in one solution it will keep for years—I have lately been using some that was made fully three years ago. and it worked with the same energy as a freshly made solution, which speaks well for its keeping qualities. The sample of Glycin that I use is made by Hauff. I believe there is another on the market which I have had no experience with.

I make the concentrated one-solution developer thus:—

Hot water	10 oz.
Soda sulphite	625 gr.
Pot. carbonate	1300 gr.
Glycin	250 gr.

This must be made up in the order given. It will be noticed there is no bromide; in the ordinary way it is not required, it need only be used in cases of over-exposure. The Glycin must only be added in small quantities at a time; on account of the effervescence that takes place. When cold, it is best to bottle it off in small bottles. say 1 oz. and ½ oz. full to the cork. The above formula is by Jules Fuerst; it was published a long time ago, it answered my purpose well. so kept to it. For ordinary work it must be diluted with three times its bulk of water, and can be used over and over again; the more concentrated the developer. the more density is obtained. with great clearness in the shadows, and the more dilute gives more softness. Great care must be taken when using glycin not to let a trace of hypo be either about the fingers or dishes, or a yellow stain all over the negative is the result. Should this stain occur, when the negative is dry. most of the stain can be removed by rubbing it with methylated alcohol on a piece of soft rag.

The gradation given by this developer is most perfect. and the advantage over pyro is that the finest detail does not get blocked up, the image is of a blackish colour, and the density can be easily judged. If used for stand development now so much in vogue, it can be diluted to 10. 20. or even so much as 50 times; the more dilute the longer time the plate takes to develop. A plate can be put into the developer and left for hours, no time need be lost, as any number can be developed at a time. I have put plates in over night, and examined them in the morning, and if not sufficiently developed I put again into the dish. For hand camera work this is the best developer I know. Many amateurs who have tried this system admit that they can get more successful results than by any other developer.

My advice to amateurs is, Try it!

A SEPIATYPE PRINTING PAPER.

By B. E. F.

A PAPER giving rich sepia tones, and which is easy to make and simple to work, is often of great use in photographic operations. The following will be found to fulfil all requirements. It prints right out, and therefore does not require development. The tones produced can be varied at will, from a Vandyke brown to red sepia, and the solution may be applied to the paper either with a brush or by floating. It consists of a solution of an organic salt of silver, and one of the well-known double salts of iron. Of the latter, either the ammonia citrate, the ammonia tartrate, or the ammonia oxalate may be used, though the last-named gives the best results, and is the quickest in printing, and the paper has the best keeping properties. I will therefore describe the method of preparation with this salt.

Make a solution of the ammonia ferric-oxalate by dissolving 1 ounce of the salt in 5 ounces of distilled water, and add a small quantity of gum water, say, about two drachms of a solution of picked gum arabic, 1 ounce in water 5 ounces. This is to keep the image on the surface of the paper, and to prevent precipitation of the silver to be added afterwards. Now take 60 grains of nitrate of silver, and dissolve in 2 drachms of distilled water. Add 60 grains of citric acid, and, when thoroughly dissolved, drop in strong ammonia drop by drop, with constant stirring and shaking. At first a dense precipitate of white silver citrate will be formed, but on continuing the addition of ammonia this will be redissolved, and the solution will be clear. Do not go quite so far as this, however, but allow it to remain decidedly milky, as excess of ammonia must be avoided. Now take your ferric-oxalate solution, and add to it 40 grains of citric acid, and after solution has taken place add the silver citrate solution a little at a time, and with constant shaking. If rightly made, the solution should be greenish in colour, and only slightly opalescent. If red, too much ammonia has been used, and citric acid should be added to restore the colour. The solution is now complete and ready for use.

For use, when the paper or cardboard, or whatever surface it is applied to, is quite dry, print in the ordinary printing frame exactly as you would ordinary P.O.P. When sufficiently exposed, take out of frame and fix. This, however, should not be done in hypo as in ordinary work. The first object is to remove the iron salt out of the paper. To do this, immerse the print in a solution of citric acid in water, made by dissolving 1 ounce of acid in 80 ounces of water. Pour a little of this into a dish and immerse the print. In about three to five minutes the yellow colour will be removed, and the print should be washed a short time in water to remove the last trace. The paper will, however, still contain slight traces of silver citrate which is not removed by the acid bath. This, however, is extremely soluble in ammonia. A short immersion in ammonia about 1 to 80 therefore completely removes all traces of silver, and the print is then permanent and finished.

By altering the organic salt of silver, various results of tone and colour may be obtained, but the method of making remains the same. The tartrates, succinates, benzoates, and quite a numerous series of similar salts may be employed, and results may be varied by dissolving these precipitates in nitric or sulphuric acids, instead of ammonia. A wide field is thus thrown open to the experimentalist.

EX ORIENTE LUX.

By Geo. Ewing, Calcutta.

The light in the present instance is only from the side, and is intended more to bring to notice recognised principles, lost sight of by amateurs, than to illuminate any brilliant discovery.

To an exile, far removed from the hub of photographic thought, and dependent on The British Journal of Photography for his information as to what is going on in the great European centres, the question of the hour apparently relates to halation and its cure. It is another case of the deepest darkness directly under the light. Now, let me throw a side-light on the discussion, and ask you and your readers to drop for a moment caramel, burnt sienna, Indian ink, gum, and gamboge and other messy abominations, and try a backing of thin black paper coated with glycerine and squeegeed into optical contact with the back of the plate. The black paper I prefer is the carbonised paper used in telegraph offices and drapers' shops for duplicating manuscript, but the black paper in which plates are wrapped will do as well. And the squeegee need not be an elaborate and costly affair, as my wife has found that the finest squeegee in the world is one of the soft long-haired brushes used for hats. Do not stint the glycerine, apply the paper to the back, give it a rub down with the brush, and place the plate in the frame. Before development, pull the paper off—for future use—and proceed with a light and joyful heart to make a negative as free from halation as the most exigent could desire.

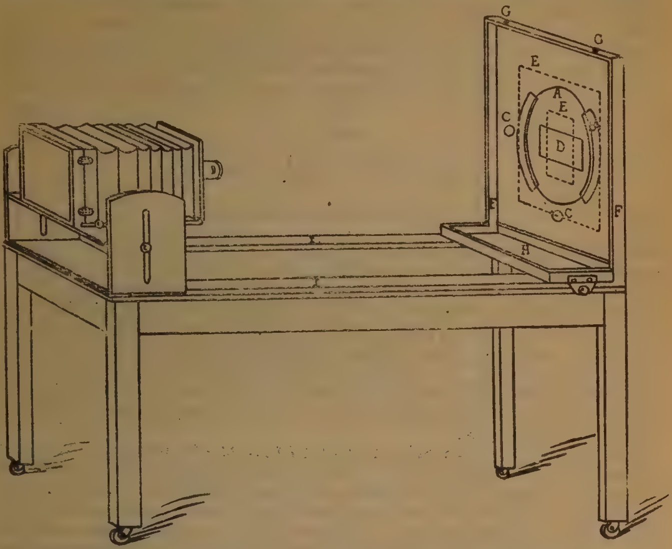
Another side-light on an old truth. A yellow screen and isochromatic plates help much to destroy the grainy appearance so common in negatives of copies. The fibres of the paper reflect yellowish shadows, which are translated into abnormally dark tones by ordinary plates.

Finally, a ray of light which may fire a powder magazine of repudiation and abuse. The bichromate of potash ray filter is the best for colour correct negatives. I like a dark tint, with plenty of exposure to secure correct rendering of blue.

A USEFUL COPYING APPARATUS.

By Lieut.-Col. C. Gardner Vatcher.

I have designed the following apparatus for straightening up the lines in negatives when making positives in the camera. I use it on the usual rails used for enlarging with a cantilever enlarger, which, with its platform, is removed to give place to the rising stand, to which is screwed the camera. You will see in my rough sketch that the space between the uprights that support the drawing-board (to pin the bromide paper to) is filled in with ½ in. wood. In the centre of this, facing the camera, a circle 9¼ inches is cut, and a disc 9½ inches is fitted in, rabbeted ¼ in., the circle being also rabbeted to correspond, to shut out all light save that through the negative. The disc should revolve loosely in the circle, and be quite flush the side facing the camera. On the side reverse from the camera, but shown on the sketch facing it, two arcs of brass about 6 inches long are screwed at each end of the diameter. These form a stop to prevent the disc falling out of the circle. In the centre of the disc, and arranging it so that the longest lines are parallel with the diameter of the circle, the opening for a half-plate negative is cut out, with the rabbet the



A. Revolving disc. B B. Arcs of brass. CC. Milled screws clamping brass arcs. D. Rabbeted aperture for ½ plate. E E. Mask of zinc. F F. Easel uprights. G G. Round-headed screws to which to hang drawing-board. H. Tray for drawing-pins. I I. Rails.

reverse side to the camera. Two buttons hold the negative in its place. Two milled screws, placed at six o'clock and nine, if the circle represented a clock face, are placed to clamp the disc in the desired position. On the side facing the camera represented in the sketch by dotted lines a square of zinc, with an oblong cut in it slightly smaller than a half-plate, slips into catches, and, of course, can be placed upright or horizontal, according to the position of the negative. As carriers for quarter-plates are used, so another mask of zinc has to be cut in the same way as for the half-plate, slightly smaller than quarter-plate. To users of a hand camera this apparatus will prove most useful.

COLOURING LANTERN SLIDES.

By Osborn Thornbery.

There is no doubt that photographic lantern slides artistically coloured are a great improvement on the plain ones. They are also of educative value, as, for instance, in Eastern scenes, where natives are shown in their every-day costumes; the plain photographs fails to convey to the eye the medley of pretty colours which are so pleasing and interesting. A great many of the coloured photo slides are overdone, being very gaudily tinted by a so-called artist who has paid no attention to nature's own beauty, but has relied on his vivid imagination, with the result that a peaceful English spring has a blazing tropical summer sky.

What is required is to simply tint to take the plainness off and give it some idea of colour. The greater number of coloured slides are painted too deeply, which blocks the detail and makes them appear too gaudy. Transparent paints only must be used, as it stands to reason that opaque colours only show colour on the surface, and, as the light must travel through it, the opaque paint would show nothing but a black patch. Water colours may be used, but it requires an experienced hand to be able to successfully colour with them on a gelatine surface on account of its propensity to swell when it comes in contact with water. Oil colours, on the whole, will be found the best, being easiest to apply, and can be removed expeditiously by means of a piece of linen dipped in turpentine, if unsuccessfully applied.

There are about five colours that are truly transparent, but if judgment is used in their mixing a variety of tints may be obtained. There are other colours semi-transparent, but their use should not be attempted by a beginner, as they must be very sparingly applied. The most suitable colours are:—Burnt sienna, burnt umber, crimson lake, Italian pink (this colour is not pink, but yellow), and Prussian blue. A useful addition to the above is ivory black. This is opaque, and is splendid for blocking-out backgrounds, etc. They may be bought at any artists' colourman's in collapsible tubes for 3d. or 4d. each. Three brushes will be required. They must be sables, on account of the fineness of tinting required on a slide. Nos. I., II., III. are the best sizes. They will cost about 6d. each. When purchasing, damp the finger and thumb and draw the sable up to a point. If it makes a ragged one, do not buy. A good sable ought to go up to a very fine point. It will be found that water-colour sables are the best for our purpose, as they are so much softer than those sold for oils.

For an easel there is not anything more suitable than a retouching desk, as all light except that which comes through the slide must be kept out. A palette need not be purchased—a piece of glass making an excellent substitute, and the density of the colours can be better judged on it. Before attempting to colour, the apartment in which the work is to be done must be thoroughly dusted out, not with a dry duster, but with a damp one. This will effectively remove all superfluous dust which would otherwise settle on the work and spoil it. Of course, the colours in the state in which they are sold are far too thick, and for use will have to be considerably thinned with spirits of turpentine. It is best to purchase the latter at a chemist's, as it is cleaner and more pure than that sold at oil stores.

The mistakes beginners usually make are either having the paint too thick or too thin, painting over the edges, and working too rapidly. These, of course, are soon overcome with a little practice. If the paint is too thick the brush marks will show, and if too thin the colour will run and collect at the edges. It is required to strike the medium, which will only come by experience, as some makes of paint are much thicker than others. It must be lightly laid on with the sable, first gently painting round the edge of the object, and then evenly filling in the centre. For very fine work the smallest sable must be used, and for larger, such as the sky, No. 3 will be found best. Even when a large brush is used, the surface, if it is a fair size, cannot sometimes be evenly covered without any marks showing. To ensure an even surface, what is known as "dabbing" will have to be resorted to. To do this the top of the third finger of the right hand must have the ridges on it rubbed smooth with a piece of fine emery paper. The slide must be held firmly on the desk with the left hand, while the prepared finger gently dabs the painted surface. The finger must work from left to right, and then turned crosswise, and worked away from the body till the surface is perfectly even. Success cannot be expected the first time, but it will come with practice. It must be remembered that the lighter the dabs, and the more uniform they are, the better will be the result. The "artisticness" of the slide will, of course, depend upon the taste exercised in arranging the colours. Beautiful sunset effects can be obtained by tinting the lower portion of the sky orange or pink, and the upper light blue. It must be remembered in colouring water that its colour is reflected from the sky and surrounding objects. Now, with regard to the obtaining of the different tints. A variety of different greens may be had by mixing Italian pink with Prussian blue. For a yellowish-green use more Italian pink, and for a dark green more blue. Other green tints may be made by mixing burnt sienna with the two above colours. A splendid purple is made with Prussian blue and crimson lake. The more of the latter that is used the warmer will be the purple. For a deep orange, crimson lake must be mixed with Italian pink. Burnt sienna and burnt umber form a very good tint for mountain sides, rocks, and roads.

NOTES UPON GELATINE PLATES.

By J. Barker.

Whilst engaged upon some experiments re the latent image, the following, amongst other old makes of gelatine plates, were exposed and developed with the object of determining whether the primary sensitiveness of the haloid salt, when first formed into a light sensitive compound, was itself permanent or not:—(1) Bromo-iodide plates made by myself about 1878; (2) Britannia plates, about 1880; (3) Swan's plates, about 1879; (4) Cobb's Invicta plates, about 1879; (5) plates made about 1879 by myself to Bennett's formula and stewed for seven days.

The same exposure was given, and the same pyro-soda developer used in each case.

The gelatine showed signs of incipient decomposition in every plate after development, though not sufficient to have any effect upon the printing value of the negatives, the results being as follow:—(1) Very good, slightly under-exposed, good density, clear shadows; (2) good, exposure about correct, good density; (3) rather over-exposed, slightly thin; (4) exposure about correct, thin, with clear shadows, which is noticeable, seeing that these plates did not give quite clear shadows originally, and the thickness of the glass would astonish some present-day workers; (5) good clear negative, exposure correct, good density, but frilled badly.

Although the method of packing was different in each of the five examples quoted, the keeping qualities did not seem to be influenced in the least, as the plates were all in good sensitive condition.

It does not seem to matter whether a gelatine emulsion is prepared with an excess of bromide, exact equivalents or excess of silver, provided said excess be removed by some means, and not left in the emulsion, as, although said excess does not seem to have much effect upon the primary sensitiveness, it has a decided effect upon the latent image, and also upon the keeping qualities of the emulsion, and it is curious that, although iodides have the greatest effect, bromides coming next, and chlorides the least effect upon the latent image. This order is exactly reversed as regards keeping qualities, as a chloride emulsion will not keep so long as a bromide emulsion, and an iodide emulsion will keep longer than either of the others.

The general sensitiveness of every sample seemed to be increased, and it is probable that the decomposition of the gelatine that had commenced had caused this increased sensitiveness, although the part that organic matter plays in this connection has yet to be defined.

RELATIVE EXPOSURES FOR COPYING PURPOSES.

By C. Welborne Piper.

A study of the Abbé theory reveals the fact that Mr. W. E. Debenham's table of relative exposures, given in this Almanac, only gives strictly correct results with lenses of a particular class, that is, with lenses of constant aperture, which expression implies the fact that the effective aperture of the lens is the same on either side. This is, or should be, the case with all doublets of symmetrical construction, and it is, indeed, probably the case with most, if not all, of the doublets in common use, including the non-symmetrical types. With single lenses of the view or landscape type, it is, however, not the case, as most people know, for the effective aperture is greater at the back of the objective than it is on the side of the stop. If such lenses are used for copying or enlarging purposes (and they are frequently supplied in cheap enlarging cameras) the relative exposures given by the tables do not apply accurately. The variations from the table exposures can, however, be easily calculated if we know one factor concerning the lens, and that is the distance from the node of admission to the Abbé entrance pupil. Fortunately, this factor, which I term the Abbé constant, can be easily determined in a single lens, for, when the stop side of the lens is turned towards the object the stop aperture is the pupil, and the distance from it to the node can be easily measured, while if the stop is turned towards the image the pupil is a virtual image of the stop aperture, and its distance from For example, with a 6 in. lens we find by direct measurement that the lens node can be determined by the law of conjugate foci. the stop is situated, say, 2 in. from the node of admission of the lens which is behind the stop. The Abbé constant is therefore 2 in. for this position of the objective. If now we reverse the objective we can find the position of the virtual image of the stop from the formula $\frac{1}{u} - \frac{1}{v} = \frac{1}{f}$. Substituting 2 ins. for u and 6 ins. for f we find that $v=3$ in., which is the distance from the entrance pupil to the node of emission of the lens. The nodal space of the lens being added to or deducted from this dimension, according as the space is positive or negative (nodes separated or crossed), we arrive at the Abbé constant for the reversed position of the lens. The exact relative exposures can now easily be arrived at by multiplying those given in Mr. Debenham's table by the following factor, R being the ratio of image to object as given in the first column of the table, f being the focal length of the lens, and C the Abbé constant, which it should be noted is a positive quantity when the pupil is behind the node of the lens, and a negative quantity when the pupil is in front of the node.

$$\left(1 + \frac{\mathrm{RC}}{(\mathrm{R}+1)f}\right)^2$$

To give a particular example, assume that we have a 6 in. lens with a positive constant of $+3$ in. and a negative constant of -2 in. For enlarging purposes it is desirable to use the lens with stop towards the image, or with a positive constant, so we will consider that case first, and compare the exposure for an enlargement of 6 diameters with that required for copying full size.

R being equal to 6, f to 6, and C to $+3$, we must multiply the table exposure of 12.25 by $\left(1 + \frac{6 \times 3}{(6+1)\,6}\right)^2$ or by $(1\tfrac{3}{7})^2$. This gives a value of 25.

In the case of copying full size, R=1, and we multiply the table exposure of 1 by $\left(1+\frac{3}{(1+1)\,6}\right)^2$ or $(1\frac{1}{4})^2=1{\cdot}5625$.

The relative exposures for copying full size and enlarging 6 diameters are therefore as 1.5625 : 25, or as 1 : 16 instead of 1 : 12.25 as in the table.

Next, we may take the case of the same lens reversed, or with a negative constant of −2.

When enlarging 6 times we multiply 12.25 by $\left(1-\frac{6\times2}{(6+1)\,6}\right)^2$, or by $(1-\frac{2}{7})^2$ or $(\frac{5}{7})^2$, which gives as a result 6.247.

When copying full size we multiply the table exposure of 1 by $\left(1-\frac{2}{(1+1)\,6}\right)^2=(1-\frac{1}{6})^2=(\frac{5}{6})^2=.694$.

The relative exposures are therefore as .694 : 6.247, as as 1 : 9, instead of 1 : 12.25.

We have considered a slightly unusual case as an enlargement of 6 diameters is more than is often necessary; and, further, the constants for a 6 in. lens may well be less than —2 and +3 in. but the case is a good illustrative one, and not over-exaggerated. The constants are not likely to be in any case much under a quarter and a third of the focal length, and a big scale of enlargement always renders the variations of importance. It will be noticed that the exposures for copying full size vary considerably. The exposure for a 6 in. lens of constant aperture being 1, that for the two positions of the inconstant lens is 1.5625 and .694, the same effective aperture being used in each case. The fact that such variations can exist between lenses of equal focal length and aperture is probably unknown to the majority of photographers, who will be, perhaps, somewhat surprised to learn that two different lenses, both working at, say, *f* 16, are not necessarily of the same rapidity, and that it is even possible for one to be more than twice as rapid as the other, as in the above example.

A FEW MORE NOTES ON HAND CAMERAS.

By H. Selby.

There appears to be no finality about hand cameras. The ideal one has yet to be invented: but we seem to be gradually approaching that desideratum. The favourite form, judging by what one sees, appears still to be of the box type, with innumerable knobs and levers, with finders which flash in the sunlight, and with various other features which indicate to all and sundry that the bearer is a hand-camera fiend. Further, the favourite plate-changing device seems to be that in which the plate is allowed to drop down with an amount of violence to which, I personally, should not care to subject any plate to which I attach much value. I must say I prefer a camera which can be used either as a hand or stand camera. The great time for using a camera with most of us is just that time when we don't care to hamper ourselves with more than one instrument, viz., in our holidays. And it happens that the type in which the greatest improvements are being made is, so far as I can judge, the one which is best adapted for the dual purpose. I refer to the modified box form, in which, by touching a spring, the baseboard is made to drop, and the bellows are pulled out to a fixed focus point. In this form of camera a good amount of extension is possible—sufficient, in fact, to enable the newer forms of lenses to be used at 3-foci. The favourite shutter in these cameras is unquestionably the Bausch and Lomb "Unicum." This is an excellent shutter in intention, but in practice it does not, to my mind, act up to its intention. It has a fairly wide range, enough for all ordinary purposes, but the points at which it acts within that range are too wide, and moreover, I fear its accuracy of exposure at those points is not, well—shall I say—scientifically accurate. I have seen a negative exposed at the one-thousandth of a second with this shutter, and from the result, and knowing the conditions, I would stake my reputation by saying it had not more than half a second Still it is a very useful shutter with a plate that allows plenty of latitude in exposure. Goerz's sector shutter is a finer one, but its price is alarming. The shutter, which I spoke very highly of a year or two back, is now, I find, being fitted to the Nydia camera. But (shall I whisper such a calumny?) I am told it is guilty of vibration. Perhaps this fault is now cured; or even existed only in the particular instrument of which it was spoken.

While I write, a new camera of the type I am recommending is reviewed. It emanates from the Thornton-Pickard Company. It has a focal plane, and also a between-lens shutter. When the baseboard drops, the bellows, with the lens front, springs forward to the fixed focus point automatically. I have not full details before me, but I should say that, if for purposes of stand camera work it has a reversing back, it must be pretty nearly the ideal camera we are all longing for.

EPITOME OF PROGRESS IN 1901

COMPILED BY THE EDITOR.

ON RED AND PURPLE CHLORIDE, BROMIDE, AND IODIDE OF SILVER; ON HELIOCHROMY, AND ON THE LATENT PHOTOGRAPHIC IMAGE.

By the late **MATTHEW CAREY LEA.**

I.

[These valuable papers of the late Mr. Carey Lea, formerly published in THE BRITISH JOURNAL OF PHOTOGRAPHY, are reprinted at the request of several readers interested in the study of pigmentary colour photography.]

IN this series of papers it will be my object to show: (1.) That chlorine, bromine, and iodine are capable of forming compounds with silver exhibiting varied and beautiful colouration, peach-blossom, rose, purple, and black. That these compounds (except under the influence of light) possess great stability; that they may be obtained by purely chemical means, and in the entire absence of light. (2.) That of these substances the red chloride shows a tendency to the reproduction of colours. It seems not improbable that the material of the infinitesimally thin films obtained by Becquerel, Nièpce de St. Victor, Poitevin, and others in their experiments on heliochromy may be the red chloride. (3.) That these substances, formed by purely chemical means, constitute the actual material of the latent or invisible photographic image, which material may now be obtained in the laboratory without the aid of light and in any desired quantity. They also form part of the visible product resulting from the action of light on the silver haloids.

For more than a generation past the nature of the latent photographic image, that which forms the basis of development, has been in dispute. Two theories have been maintained. According to the one, the first effect produced by light is simply a physical change, predisposing the elements of the silver haloid to dissociation, so that when a reducing agent is applied, the molecules so affected yield more quickly to its influence. According to the other theory, the invisible image is formed of a subsalt (sub-chloride, etc.). Observations which I published many years ago led me strongly to the first-mentioned of these theories. But, of late years, results have been obtained not easily reconcilable with it. On the other hand, the theory that the latent image is formed of subsalt is opposed to striking facts. Silver sub-chloride, for example, is an unstable substance, quickly destroyed by dilute nitric acid. But I have formed a latent image on silver chloride and after exposing it for five minutes to the action of strong nitric acid (s.g. 1.36) have developed the image without difficulty; the same with silver bromide. Evidently these images, which so strongly resisted the action of undiluted acid, could not be formed of simple sub-chloride and sub-bromide of silver, substances quickly destroyed by it.

In the desire to find a satisfactory explanation of the nature of the image based on adequite chemical proof, I have devoted nearly three years of laboratory work to this and to closely allied subjects. I am led to the conclusion that neither of the older views is correct. A truer theory seems to be deducible from the result of some experiments which I published in 1885, to the effect that the silver haloids were capable of uniting with certain other substances, much in the same way that alumina forms lakes. When a silver haloid was precipitated in the presence of certain colouring matters they combined with it, and, though soluble in water, they could not be subsequently washed out. They had formed a somewhat stable compound, although the proportion of colouring matter was very small in comparison with the haloid; evidently much too small to represent a stoichiometrical composition. Now, I find that a silver haloid may in the same way unite with a certain proportion of its own subsalt, which, by this union, quite loses its characteristic instability and forms a compound of great permanence.

Another explanation is possible; the subsalt may combine with the normal salt, not in the manner above described, but in stoichiometrical proportion, and this compound may be diffused through ordinary silver haloid. I have not been able to find any reaction decisive between these explanations,[1] but the general behaviou of the substance seems rather to indicate the first-named explanation as the true one. When the red chloride, for example, has been boiled with dilute nitric acid for a few moments to eliminate any uncombined sub-chloride, the proportion of sub-chloride left has never exceeded eight or nine per cent. in over thirty specimens analysed. If we took this to represent a compound in equivalent proportions, we should have to suppose the union of at least twenty equivalents of $AgCl$ with one of Ag_2Cl, which is improbable. If we suppose that these coloured substances containing from less than one-half per cent. up to eight or nine per cent. of Ag_2Cl consist of a compound of one equivalent of sub-chloride united to a small number of equivalents of normal chloride, mixed mechanically with a large quantity of normal chloride, then it would be improbable that specimens could not be obtained containing a larger proportion of this compound, and consequently of Ag_2Cl; but, as already said, specimens containing more than nine per cent. after thorough treatment with nitric acid to remove the uncombined sub-chloride I have never obtained; generally the amount is less.

Even when silver chloride, bromide, or iodide, contains as little as one-half of one per cent. of subsalt combined, its properties are greatly changed. It has a strong colouration, and its behaviour to light is altered. Even a much less quantity, one inappreciable to analysis, is capable of affecting both the colour and the behaviour to light. It is one of these latter forms of this substance that constitutes the actual material of the latent photographic image. Adequate proof of this will be given in the second part of this paper.

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[1] Silver chloride may be dissolved out by hot solutions of sodium or ammonium chloride, but the sub-chloride is at the same time decomposed. See beyond under head of "Reactions."

Red Silver Chloride.

Of the three haloids, the chlorine salt is the most interesting, because of its relations to heliochromy; it is also the most stable of the three compounds, and exhibits, perhaps, a finer variety of colouration, though the bromide and iodide are also obtainable of very beautiful tints. The chloride shows all the warm shades from white to black through the following gradations: white, pale flesh colour, pale pink, rose colour, copper colour, red-purple, dark chocolate, black.

These compounds are obtained in an endless variety of ways: by chlorising metallic silver; by acting on normal chloride, with reducing agents; by partly reducing silver oxide or silver carbonate by heat and treating with HCl; by forming sub-oxide or a subsalt of silver and treating with HCl, followed by nitric acid; by acting on sub-chloride with nitric acid or an alkaline hypochlorite, etc.; by attacking almost any soluble salt of silver with ferrous, manganous, or chromous oxide, etc., followed by HCl; by reducing silver citrate by hydrogen, and treating it with HCl; by treating a soluble silver salt of almost any silver solution with potash or soda, and almost any reducing agent, cane sugar, milk sugar, glucose, dextrine, aldehyde, alcohol, etc., and supersaturating with HCl; there is no organic easily oxidisable substance that I have tried that has failed to give this reaction. Also almost any salt of silver exposed to light, treated with HCl, and then with hot strong nitric acid, yields it. Almost any of these classes represents a long range of reactions, each susceptible of endless variation. In fact, the more the matter is studied, the more extended the range of reactions is found to be that give rise to the formation of this substance. To show how slight an influence will lead to the production of red chloride instead of white, if freshly precipitated argentic oxide is mixed for a few moments with starch or tragacanth paste, and is then treated with HCl, the result is, not white, but pink, silver chloride. Even raw starch flour mixed with silver oxide will, in a few moments, cause it to give a pale flesh-coloured chloride with HCl. Boiled starch or tragacanth paste does this more quickly, and acts more strongly, even in the cold, and still more if heat is applied.

Although red is probably the most characteristic colour of this substance, so that I have spoken of it above as red chloride, nevertheless this hardly seems a proper name for a substance that is often purple, chocolate, or black, sometimes brown or even ochreous, sometimes lavendish or bluish, and is probably capable of assuming every colour of the spectrum. To call it argento-argentic chloride would infer a stoichiometrical composition that, as already mentioned, seems very uncertain, too much so to serve as the basis of the name. Therefore, and as these substances have been hitherto seen only in the impure form in which they are produced by the continued action of light on the normal salts, it might be convenient to call them photo-salts, photo-chloride, photo-bromide, and photo-iodide instead of red or coloured chloride, etc., and thus to avoid the inexactness of applying the term red chloride to a substance exhibiting many other colours.

Photo-chloride by Action of Alkaline Hypo-chlorites.

Black or purple-black chloride is easily obtained by the action of an alkaline hypo-chlorite on finely divided silver, such as obtained by reduction in the wet way. Commercial sodium-chlorite may be used to act on it. It is to be poured over the silver, and, after standing a few minutes, is to be replaced with fresh. After an hour or two this is again to be replaced with a new portion, which is to be allowed to act half an hour to ensure the total conversion of the silver. The product varies somewhat in colour, is sometimes black, oftener purple-black. If the treatment with hypo-chlorite has been thorough, strong cold nitric acid of 1.36 s.g. extracts from it no silver. This reaction with nitric acid is important, as it shows that not only metallic silver was not present, but that the product contained absolutely no uncombined sub-chloride; for, if any were present, it would instantly be decomposed by the acid, in which one-half of its silver would dissolve. The action, therefore, appears to take place in this way. First sub-chloride is formed, part of this is further chlorised into normal chloride which at once combines with other sub-chloride, thus taking it out of the further immediate action of the hypo-chlorite, and this goes on until an equilibrium is reached, and neither metallic silver nor uncombined sub-chloride is left, as is proved by the action of nitric acid. Alkaline hypo-chlorite, as will presently be shown, attacks uncombined sub-chloride very rapidly, the combined very slowly; by many days' contact the quantity of combined sub-chloride is gradually reduced.

Prolonged treatment with hot strong nitric acid destroys all the varieties of photo-chloride. The time needed varies a good deal. A specimen of that obtained with hypo-chlorite required twenty-five hours' heating with acid of 1.36 in a water bath at 212° Fahr. to bring it to the condition of white normal chloride. Considering that cold dilute nitric acid instantly destroys freshly precipitated argentous chloride in the free state, this long resistance to strong acid at the temperature of boiling water must be considered most remarkable.

When the red or photo-chloride is formed with the aid of a ferrous salt or ferrous oxide, I prefer to boil the product with dilute HCL to get rid of the last traces of iron, after a preliminary treatment with hot dilute nitric acid has removed silver and uncombined sub-chloride. The photo-chloride will sometimes even resist boiling aqua regia for a time.

Protected from light, photo-chloride is perfectly stable. Specimens obtained eighteen months ago appear to be quite unchanged.

When treated with ammonia, it is far more slowly attacked than the normal. The ammonia dissolves the normal chloride only. The union between the two must therefore be broken up, and this takes place slowly. The first action of the ammonia is to change the red or purple colour to greenish-black and then to slowly dissolve out silver chloride. Hours are required even with a large excess of ammonia. Whilst this is going on, if the ammonia is poured off and replaced with nitric acid, the original colour reappears. If the action is continued sufficiently long, silver only remains, and dissolves readily in nitric acid. A little short of this, treatment with nitric acid leaves a black residue of dark chloride mixed with metallic silver. The dark chloride being insoluble in any acid has led to some strange mistakes in a similar reaction which occurs in treating with ammonia silver chloride that has been exposed to the light. Even a theory has been had recourse to of a "passive condition" of silver. This passive silver is simply black chloride.

A specimen of purple-black chloride was treated with warm strong aqua regia until whitened by conversion of the sub-chloride to normal. By this treatment 2.563 grammes of photo-chloride gained nine milligrammes, indicating the presence of two and a half per cent. of sub-chloride, or, more exactly,

Sub-chloride	2.49.
Normal chloride	97.51.

This is not to be taken in any sense as representing a constant composition. The proportion of sub-chloride varies between certain limits, not only according to the method of preparation used, but independently of it. Another specimen of black chloride formed with hypo-chlorite gave figures that indicated a constant of less than half of one per cent. of sub-chloride.

PHOTO-CHLORIDE BY REDUCTION OF NORMAL CHLORIDE.

This is an excellent means of obtaining red chloride. The white chloride is to be dissolved in ammonia and ferrous sulphate added, producing an intensely black precipitate. After standing a minute, the mixture is to be treated with dilute sulphuric acid until it shows a strong acid reaction.

The precipitate is to be first well washed by decantation, then boiled first with dilute nitric, then, after washing, with dilute hydrochloric acid, which must, of course, be thoroughly washed out.

The product obtained in this way is often of singular beauty. It might easily be taken for metallic copper. Sometimes it is as rich and bright in colour as the copper obtained by electric deposition. Every one knows the richness and brilliancy of that form of copper, and I have seen it fully equalled by this silver salt.

The beauty of the colour depends always on the thorough removal of any metallic silver that may be present, and still more on getting rid of every trace of iron. The boiling with dilute hydrochloric acid should be continued until, after thorough washing, a fresh treatment extracts no more and the acid remains colourless in presence of alkaline sulphocyanide.

Instead of an ammoniacal solution of silver chloride, we may make a solution of any other silver salt in ammonia and reduce it in the manner just described with ferrous sulphate. But in this case hydrochloric acid must be used instead of sulphuric after the reduction. This single reaction includes an almost endless variety of methods. The acid with which the silver was originally combined seems to be not without influence on the result; in some cases, for example, with arseniate and molybdate, the action of coloured light on the red chloride seems to be somewhat modified. Silver phosphate, on account of the ease with which it suffers reduction, is very well adapted for this treatment.

PHOTO-CHLORIDE BY PARTIAL REDUCTION OF OXIDE BY HEAT, AND TREATMENT WITH HCl.

This method has the advantage of avoiding all admixture of foreign substances, the last traces of which are very hard to get rid of, and seem to exert an effect on the colour disproportionate to their quantity. Accordingly the photo-chloride obtained in this way is very beautiful, the shades are from pink to copper red, and a tint resembling burnt carmine.

Heat may be applied to the oxide in either of two ways, long-continued heat at 212° Fahr., or near it; or the change may be effected by roasting.

When slow heat is to be applied, care must be taken that the oxide does not carbonate itself, which it easily does superficially; this is an objection, because the carbonate, under these circumstances, yields white chloride with which the other becomes mixed. The air of a drying oven heated by a gas burner is especially bad in this respect. I have seen a surface of oxide form a coat of yellow carbonate in a few hours in this way. (Most oxide that has been kept some time will effervesce briskly with an acid.) The method is uncertain, sometimes giving strongly coloured products and sometimes pale pink.

The oxide may be roasted in a shallow, flat-bottomed porcelain basin. With a very moderate heat it changes from brown to black. When this is thoroughly accomplished and before grey reduction sets in, the oxide is to be treated with HCl. If this be done in the basin itself after cooling and without disturbing the position of the oxide, a curious variety of tints will be noticeable, depending upon slight differences in the heat affecting different portions.

II.

Silver Carbonate may be roasted in the same way as silver oxide, and yields a similar product. By heat its colour changes from yellow to black; it is probable that the carbonic acid is driven off at a lower temperature than that at which oxide is reduced to silver, and that with it escapes part of the oxygen. The residue is converted by HCl into deep red chloride.

ACTION OF VARIOUS METALLIC OXIDES ON SILVER OXIDE.

If we precipitate ferrous oxide with potash and add to this silver oxide, or, what amounts to the same thing, if we add to ferrous sulphate potash in excess and pour over this silver nitrate solution, the silver oxide separated by the potash is partly reduced by the ferrous oxide, and when treated with HCl forms red chloride, the intensity of the colour of which depends within certain limits on the amount of reduction of the silver oxide.

Similarly if we treat solution of manganous sulphate with excess of potash, and then add silver solution, we get an analogous reaction, except that it is much weaker and heat is necessary.

With chromous oxide the action is still weaker, but evident. With cobaltous oxide it is scarcely perceptible without heat and long-continued action.

ACTION OF FERRIC CHLORIDE ON METALLIC SILVER.

It has long been known that silver was blackened by ferric chloride, and this action has been proposed in the text-books as a means of obtaining sub-chloride, for which it is quite unsuited.

Ferric chloride acts on silver much as sodium hypo-chlorite does, but less rapidly. With hypo-chlorite the action is complete in a few hours, or often in an hour or less; with ferric chloride one or two days are required before the product ceases to yield silver to hot dilute nitric acid. In both cases the action appears to be alike in this, that no sub-chloride is finally left uncombined with normal chloride.

The product is an intensely dark purple-black when the action takes place in the cold. With heat continued for many hours, ferric chloride can be made to attack the purple salt and gradually convert it into AgCl. With a strong solution in large excess at or near 212° Fahr. for sixty hours the colour was gradually reduced to pink, and finally to a dingy pinkish grey. Pure white cannot be obtained, as it can by aqua regia.

In order to observe more exactly the course of the action, a strong solution of ferric chloride was allowed to act on reduced silver in fine powder for four minutes, and then a fresh portion (always in large excess) for the same time. Analysis showed that at this stage of the action the material contained—

Ag (determined)	76.07
Cl (by difference)	23.93
	100.00

If we suppose that all the silver was combined with chlorine, the constitution of the substance would be—

AgCl	92.49
Ag_2Cl	7.51
	100.00.

But this was probably not the case; there was almost certainly free silver present, and consequently a less proportion of sub-chloride. Another specimen, treated repeatedly with hot acid until every trace of free silver was removed, was found to contain 1.52 per cent. of sub-chloride, colour purple. Another similarly treated contained 7.3 per cent. of sub-chloride.

Action of Nitric Acid on Silver Sub-chloride.

When freshly precipitated, and still moist, sub-chloride of silver is treated with nitric acid, a sharp effervescence accompanied with a disengagement of red fumes sets in; presently the strong red colouration of the photo-chloride appears and the action ceases. This production of the red and not white chloride in the decomposition of Ag_2Cl is precisely what might have been expected, for, when AgCl is formed in the presence of Ag_2Cl, more or less combination always takes place.

The action is interesting in this respect: the AgCl first formed is at the moment of formation in presence of all the yet undecomposed portion of Ag_2Cl, and whatever part it combines with is removed from the action of the acid. It would therefore seem probable that this method would be one of those that yielded a product having the largest proportion of Ag_2Cl, but analysis showed that different specimens were extremely variable—of those analysed, one contained 8.62 per cent. of Ag_2Cl, another 6.56, and a third 1.96. All that analysis can do with such substances is to fix the limits within which they vary. The quantity of sub-chloride left after treatment with nitric acid depends partly on the strength of the acid and the time for which it is allowed to act, but also to some extent on variations in the resistance of the substance itself. These specimens were of shades between rose and purple.

The colour of any particular specimen is always lightened in shade by abstracting Ag_2Cl from it by continued boiling with nitric acid. But as between different specimens, especially when formed by different reactions, it by no means follows that the darkest in colour contains the most sub-chloride.

Argentous chloride when treated with sodium hypo-chlorite yields a purple form of photo-chloride. A specimen so treated contained 2.57 per cent. of Ag_2Cl.

Action of Cupric Chloride on Silver.

When metallic silver is submitted to the action of either cupric chloride, or, what gives the same result, a mixture of copper sulphate and ammonium chloride, an action takes place very similar to that of ferric chloride, but more energetic, and the resulting red chloride is apt to be lighter in shade, though in this respect it varies very much. As in the case of ferric chloride, this action of cupric chloride on silver is given in some text-books as a means of obtaining argentous chloride, for which purpose it is as little suited as the iron salt.

As a mode of obtaining red chloride it is not to be recommended. It is troublesome to get the copper completely removed. A specimen analysed was found to consist of white chloride with 6.28 per cent. of sub-chloride.

ACTION OF PROTO-CHLORIDES ON SILVER SOLUTION.—CUPROUS CHLORIDE.

When very dilute solution of silver nitrate is poured over cuprous chloride, a bulky black powder results, which by boiling with dilute nitric acid turns red, the acid extracting little or no silver.

FERROUS CHLORIDE.

When silver nitrate is dissolved in a slight excess of ammonia, and this solution is poured into a strong one of ferrous chloride, there results a precipitate which is sometimes greyish, sometimes olive black. By washing with dilute sulphuric acid this product becomes greyish-purple, and brightens by boiling with dilute nitric acid. It was found to contain 4.26 per cent. of sub-chloride.

PHOTO-CHLORIDE BY ACTION OF HYDROGEN.

When hydrogen is passed over argentic citrate at 212° Fahr., as is Wôhler's process, there results a black or dark brown powder consisting of argentous citrate, metallic silver, and perhaps other substances. When this is treated with hydrochloric acid and subsequently with nitric, the resulting product is photo-chloride, the characteristic colour of which sometimes appears as soon as the HCl is added. But more frequently the material after the action of HCl has precisely the appearance of silver reduced in the wet way, and the red colour appears only after treatment with nitric acid. Even cold dilute acid (by some hours' contact) will isolate the red chloride; boiling acid does so at once.

Colour beautiful purple. A specimen analysed was found to consist of normal chloride combined with 3.11 per cent. of sub-chloride.

PHOTO-CHLORIDE BY ACTION OF POTASH WITH OXIDISABLE ORGANIC SUBSTANCES.

There is no better method of obtaining photo-chloride than by acting on a salt of silver with potash and certain organic substances. Milk sugar, dextrine, and aldehyde give particularly good results. Milk sugar acts rapidly, dextrine slowly. Other substances with which, combined with potash, I have obtained chloride, are:—gum, tannin, gallotannic acid, manna, glycerine, alcohol, carbolic acid, etc. The number might, doubtless, be indefinitely multiplied. After the action has reached a proper stage, which with milk sugar is apt to be in less than a minute, and with dextrine may take half an hour, HCl is added, whereupon the precipitate changes in appearance, but does not exhibit its characteristic colour until after boiling with nitric acid: the best result is obtained when the precipitate, after addition of HCl, has a rich chestnut brown shade,[2] which by nitric acid changes to shades of purple and burnt carmine, when milk sugar, dextrine, or aldehyde, has been the reducing agent. When the salt of silver employed has been the chloride, of course treatment with HCl is superfluous.

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[2] A specimen in this stage, and before treatment with nitric acid, was found to contain 99.68 per cent. of silver, showing it to be a mixture of metallic silver with chloride and sub-chloride.

A specimen, obtained by acting on silver nitrate with potash and dextrine, was found to contain 2.26 per cent. of sub-chloride. Another obtained with silver nitrate, potash, and milk sugar, contained only 0.34 per cent. As in former instances, these determinations are useful only in indicating the extreme variability of these substances and their approximate limits of composition.

OTHER REACTIONS LEADING TO THE FORMATION OF PHOTO-CHLORIDE.

A few more instances are here added, indicating the variety of ways in which this product may be obtained.

The following is an interesting reaction:—If a solution of ferrous sulphate is made strongly acid with HCl and solution of silver nitrate added, the silver is thrown down as white chloride. But if to the silver solution, then, on pouring the silver solution into the iron, the silver but much less than enough to neutralise the acid added to the iron solution, then, on pouring the silver solution into the iron, the silver falls as red chloride. So obtained, it has but at first a dull purple or shade, but on purification, as before described, a good product is obtained. This method, however, scarcely tends to the production of the splendid copper red shades of colour that are got by acting on silver chloride dissolved in ammonia with ferrous sulphate, and then adding dilute sulphuric acid. The shade of colour shown by any particular specimen is always of interest, because, as before mentioned, it modifies the effect exerted upon it by the spectrum.

POTASSIO-FERROUS OXALATE.

The now well-known "oxalate developer," which I described some years ago, throws down from silver nitrate a black powder; this precipitate treated with HCl scarcely alters in appearance, but, washed and boiled with dilute nitric acid changes to a deep purple.

Pyrogallol is capable of leading to the formation of photo-chloride. When ammoniacal solution of silver nitrate is poured into solution of pyrogallol in water made strongly acid with HCl, in such proportion that the mixed solutions remain strongly acid, there falls a greyish product, which by washing and treatment with hot dilute nitric acid becomes bright pink.

Ferrous oxide differs essentially in its action on silver solutions from ferrous sulphate. A silver nitrate solution added to one of ferrous sulphate precipitates grey metallic silver. But if potash or soda is first added to the ferrous solution, and then silver nitrate, followed by HCl, the red chloride is formed abundantly. This reaction is similar to that already described, in which an ammoniacal solution of a silver is added to one of ferrous sulphate.

To the same class of reactions belong the following: Silver carbonate with excess of sodium carbonate is thrown into solution of ferric sulphate, and after standing a few minutes HCl in excess is added. This silver is converted into red chloride.

It seemed possible that silver itself might be made the means of reducing its chloride. The experiment was made in this way: Freshly precipitated and still moist chloride was intimately mixed with metallic silver in fine powder and a little water. This was heated till the water boiled and nitric acid was added. After the action was over, the chloride had assumed a deep pink colour. A similar result is obtained without the aid of heat, but the resulting colour is much paler.

Analogous to this is the following: When a cake of fused silver chloride in a crucible is reduced with dilute sulphuric acid and zinc, if the reduction is interrupted when not quite finished, and the metallic silver is dissolved out with hot nitric acid, the residue of silver chloride will be found to be pink.

When HCl is brought into contact with Ag together with an oxidising agent, such as a bichromate or permanganate, it gives rise to formation of coloured chloride. These I have not specially examined, but there can be little doubt that they are identical in nature with the foregoing. So, too, when silver in contact with mixed potassium chloride and chlorate is cautiously treated with dilute sulphuric acid.

The reactions above described will serve to show under what a vast variety of conditions the photo-salts are formed. Most of the methods here described represent each a whole class of reactions, all resulting in the same general way, and these classes might, doubtless, be largely added to. Almost any silver solution brought into contact with almost any reducing agent, and then treated with HCl, gives rise to the formation of photo-chloride. Almost any chlorising influence brought to bear on metallic silver has the same result, or when silver is brought into contact with almost any oxidising agent and HCl. It may be said without exaggeration that the number of reactions that lead to the formation of photo-chloride is much larger than that of those leading to production of normal chloride.

REACTIONS OF PHOTO-CHLORIDE.

Exposed to ordinary diffused light, all the bright shades of silver photo-chloride quickly change to purple and purple-black. The darker shades are more slowly influenced.

Mercuric chloride gradually changes it to a dirty white.

Mercuric nitrate dissolves it easily and completely, but apparently with decomposition, as it can only be recovered as white chloride.

Potassic chloride seems to be without effect.

Potassic bromide soon converts it to a dull lilac, which at the end of twelve hours showed no further change.

In contact with potassic iodide the colour instantly changes to blue-grey; this change is produced by a quantity of iodide too small to dissolve even a trace of silver; the filtrate is not darkened by ammonium sulphide. With a larger quantity silver is dissolved abundantly. By acting with renewed iodide solution, the substance continually darkens and diminishes until only a few black points, barely visible, are left.

Treated with dilute solution of potassium chlorate and HCl, the red substance gradually passes to pink, to flesh colour, and, finally, to pure white.

The action of heat on the photo-chloride is very curious; its tendency is generally towards redness. Specimens appearing quite black are rendered distinctly purple or chocolate by heating to 212° Fahr. in a drying oven. Often when the substance first separates by addition of HCl, it is pure grey; this grey will often be changed to pink by simply heating to 212°. (This happens when a grey form is produced; if the greyness is due to admixed metallic silver, it is only removed by boiling with nitric acid.)

The somewhat surprising change of colour which is often seen when the crude substance is boiled with nitric acid (sometimes from dull, dark grey to crimson) is due to three concurrent actions: that of the mere heat, the removal of the silver, and the breaking up of uncombined sub-chloride.

It is not possible to dissolve out the normal chloride by a solvent like ammonium chloride from the photo-chlorides, leaving the sub-chloride behind. When red chloride is boiled with successive portions of strong solution of ammonium chloride in large excess, the material gradually diminishes, until, if the operation is continued long enough, there remains a small residue of a warm grey colour, which consists of metallic silver, and dissolves without residue in nitric silver.

If sodic chloride is substituted for ammonium chloride, the same result follows, except that the operation is greatly more tedious. If persevered in until the hot solution no longer removes traces of silver chloride, th residue consists of nothing but metallic silver.

ACTION OF LIGHT ON NORMAL SILVER CHLORIDE.

When silver chloride precipitated with excess of HCl is exposed to light, it becames with time very dark. Cold, strong nitric acid 1.36 s.g. extracts a trace only of silver.

The principal action of light on AgCl (precipitated in presence of excess HCl) consists in the formation of a small quantity of sub-chloride, which enters into combination with the white chloride not acted upon forming the photo-chloride, and thus is able to withstand the action of strong nitric acid. At the same time a trace is formed, either of metallic silver or of uncombined sub-chloride, it is impossible to say which. After a certain very moderate quantity of photo-chloride is formed, the action of light seems to cease. The cessation has been noted by many observers, perhaps most exactly by Dr. Spencer Newbury.

The nature of the product formed by the continued action of light on silver chloride seems to support the conclusion that the sub-chloride is combined with the whole of the normal chloride after the manner of lakes rather than in equivalent proportions. If the latter were the case, it seems probable that the continued action of light would extend to much greater decomposition than it is found to do.

PHOTO-BROMIDE AND PHOTO-IODIDE.

It has been already mentioned that bromine and iodine form with silver combinations in all respects analogous to those of chlorine, and it need only be mentioned that these substances are formed much in the same way as the chlorine compound. They are less stable than it, and consequently the number of reactions that lead to their production is somewhat more limited. Each, however, is formed in a great variety of ways, and with the same ease as the chloride. In colour they are for the most part indistinguishable from it, but exhibit different reactions.

RELATIONS OF PHOTO-CHLORIDE TO HELIOCHROMY.

The photo-chloride was examined both with the spectrum and under coloured glass. The rose-coloured form of photochloride was that which gave the best effect. In the violet of the spectrum it assumed a pure violet colour, in the blue it acquired a slate blue, in green and yellow a bleaching influence was shown, in the red it remained unchanged. The maximum effect was about the line F, with another maximum at the end of the visible violet, less marked than the one at F.

Under coloured glass the colours obtained were brighter; under two thicknesses of dark ruby glass the red became brighter and richer. Under blue glass some specimens gave a fair blue, others merely grey.

Under cobalt a deep blue was easily obtained, and under manganese violet a fine violet, very distinct in shade from the cobalt. Green produced but little effect—yellow was somtimes faintly reproduced but rarely. But the yellow glass of commerce, even the dark yellow, lets through portions of nearly the whole spectrum, as can readily be seen by testing it with the spectroscope.

The dark purple forms of chloride do not give as good results as the rose and coppery shades. These last have many points of resemblance with the material of Becquerel's films, resemblance of colour, probably of composition, as far as we can judge of the constitution of those films from their origin—they were far too attenuated to admit of analysis, and resemblance in the curious way in which their colour is affected by heat, so that the conclusion seems inevitable that they are at least closely related.

There is certainly here a great and most interesting field for experiment; hardly any two specimens of photo-chloride give exactly the same results with coloured light, and this suggests great possibilities. There is the very great advantage in this method over any previous, that the material is easily obtained in any desired quantity, and in a condition most favourable for experiment.

The action of light on photo-chloride can be a good deal affected by placing other substances in contact with it. Any substance capable of giving up chlorine seems to influence the action somewhat; ferric chloride often acts favourably, also stannic and cupric chlorides.

Evidently an important point in all heliochromic processes is that, as white light must be represented by white in the image, it is an essential condition that white light must exert a bleaching action on the sensitive substance employed. Red chloride does not bleach, but darkens in white light, but the property of bleaching, to a very considerable extent, may be conferred on it by certain other chlorides, and particularly by lead chloride and zinc chloride. This I look upon as very important.

Another matter of interest is exaltation of sensitiveness, and this I find is accomplished in quite a remarkable way by sodium salicylate, the presence of which at least trebles the action of light on these substances, and probably on others.

I am persuaded that in the reactions which have been here described lies the future of heliochromy, and that in some form or other this beautiful red chloride is destined to lead eventually to the reproduction of natural colours.

ALLOTROPIC SILVER.

By the late M. Carey Lea.

Early in the year 1886 I took up the study of the reduction products of silver in connexion with that of the protosalts. I commenced with Wohler's process, giving it up after a few trials as affording no satisfactory results, and sought for a more reliable means. This I found (in March, 1886), in a reaction which I still use, namely, the reduction of silver citrate by ferrous citrate. At first, however, the results obtained were most enigmatical, the products very unstable and impossible to purify. Much time was lost, and the matter was given up more than once as impracticable. Eventually, by great modifications in the proportions, stable products, and capable of a fair amount of purification, were got. Even the earlier and less pure forms were beautiful; the purer are hardly surpassed by any known chemical products.

The forms of allotropic silver which I have obtained may be classified as follows:—

A. Soluble, deep red in solution, matt-lilac, blue or green while moist; brilliant bluish-green metallic when dry.

B. Insoluble, derived from A, dark reddish-brown while moist; when dry, somewhat resembling A.

C. Gold-silver; dark bronze whilst wet; when dry exactly resembling metallic gold in burnished lumps.

Of this form there is a variety which is copper-coloured, insoluble in water, and appears to have no corresponding soluble form.

PROPERTIES POSSESSED BY ALL THE VARIETIES IN COMMON, AND DISTINGUISHING THEM ALL FROM NORMAL SILVER.

All these forms have several remarkable properties in common.

1. That of drying with their particles in optical contact, and consequently forming a continuous film.—If either is taken in a pasty condition and is spread evenly over paper with a fine brush, it takes on spontaneously in drying a lustre as high as that of metallic leaf. C, when so treated, would be taken for gold leaf, but this property is much better seen by brushing the pasty substance over glass. When dry, an absolutely perfect mirror is obtained. The particles next the glass, seen through the glass, are as perfectly continuous as those of mercury amalgam, and the mirror is as good. A and B form bluish-green mirrors; C, gold or copper-coloured mirrors.

2. The halogen-reactions.—When any of these allotropic forms of silver are brushed over paper, and the resulting metallic films are exposed to the action of any haloid in solution, very beautiful colourations are obtained. The experiment succeeds best with substances that easily give up the halogen, such as sodium hypochlorite, ferric chloride, iodine dissolved in potassium iodide, etc. But indications are also obtained with alkaline salts, such as ammonium chloride, etc., though more slowly and less brilliantly. With sodium hypochlorite the colours are often magnificent, intense shades with metallic reflections reminding one of the colours of a peacock's tail. Blue is the predominating tint. These are interference colours, caused by thin films; but whether of a normal silver haloid or a hemi-salt cannot be said. When silver leaf (normal silver) is fastened to paper and a trial made, the contrast is very striking. This matter will be more particularly examined in the second part of this paper, and is mentioned here as one of the reactions distinguishing allotropic from ordinary silver.

3. The action of Acids.—The stronger acids, even when much diluted, instantly convert the allotropic forms of silver into normal grey silver; even acetic acid, not too much diluted, does this. It is important to remark that this change takes place absolutely without the separation of gas. I have more than once watched the whole operation with a lens, and have never seen the minutest bubble escape.

4. Physical condition.—All these allotropic forms of silver are easily reduced to an impalpable powder. One is surprised to see what is apparently solid burnished metal break easily to pieces, and by moderate trituration yield a fine powder.

A.—SOLUBLE ALLOTROPIC SILVER.

A solution of ferrous citrate added to one of a silver salt produces instantly a deep red liquid (ferrous tartrate gives the same reaction, but is less advantageous). These red solutions may either exhibit tolerable permanency, or may decolourise, letting fall a black precipitate. It is not necessary to prepare the ferrous salt in an isolated form, a mixture of ferrous sulphate and sodic citrate answers perfectly.

When, however, concentrated solutions are used with a large excess of ferrous sulphate, and a still larger one of alkaline citrate, the liquid turns almost completely black. It should be stirred very thoroughly for several minutes, to make sure that the whole of the precipitated silver citrate is acted upon by the iron. After standing for ten or fifteen minutes the liquid may be decanted, and will leave a large quantity of a heavy precipitate of a fine lilac-blue colour. It is best to adhere closely to certain proportions. Of a ten per cent. solution of silver nitrate, 200 c. c. may be placed in a precipitating jar. In another vessel are mixed 200 c. c. of a thirty per cent. solution of pure ferrous sulphate, and 280 c. c. of a forty per cent. solution of sodic citrate. (The same quantity of ferrous sulphate or of sodic citrate in a larger quantity of water will occasion much loss of the silver product.) I think some advantage is gained by neutralising the ferrous solution, which has a strong acid reaction, with solution of sodium hydroxide, as much may be added as will not cause a permanent precipitate. To the quantities already given add about 50 c. c. of a ten per cent. soda solution. The reaction takes place equally well without the soda, but I think the product is a little more stable with it. The mixed solution is to be added at once to the silver solution.

The beautiful lilac shade of the precipitate is rather ephemeral. It remains for some time if the precipitate is left under the mother water; but when thrown upon a filter it is scarcely uncovered before the lilac shade disappears, and the precipitate takes a deep blue colour without losing its solubility. It may be washed either on a filter or by decantation with any saline solution in which it is insoluble, and which does not affect it too much. On the whole, ammonic nitrate does best, but sodic-nitrate, citrate, or sulphate may be used, or the corresponding ammonia salts. Although in pure water the precipitate instantly dissolves with an intense blood-red colour, the presence of five or ten per cent. of any of these salts renders it perfectly insoluble. I have usually proceeded by adding to the precipitate (after decanting the mother water as completely as may be, and removing as much more with a pipette) a moderate amount of water; for the above quantities about 150 c. c. Much less would dissolve the precipitate but for the salts present; this much will dissolve the greater part, but not the whole, which is not necessary. A little of a saturated solution of ammonic nitrate is added, just enough being required to precipitate it from its solution.

As the material appears continually to change, the amount of washing needed must depend on the object in view. If wanted for analysis, the washing must be repeated many times until ferric salt ceases to come away, but no amount of washing will entirely eliminate it. After seven or eight solutions in pure water, and as many precipitations, the material is to be thrown on a filter, the liquid forced out as completely as possible with a pump, and then the ammonic nitrate washed out with ninety-five per cent. of alcohol until the filtrate leaves nothing on evaporation. The substance at this point is still soluble, though much less so than at first. During the washing the solubility slowly but steadily diminishes, a fact rendered noticeable by less and less ammonic nitrate being required to precipitate it from its solution.

Analysis.—The product, after thorough washing, as above described, with alcohol, was dried at ordinary temperatures, or a little above, and was then reduced to very fine powder, and washed again with water as long as anything dissolved. It was then dried at 100° C. in a water bath. Three silver determinations were made:—

A_1	97.31	per cent. silver.
A_2	97.18	,, ,,
B	97.21	,, ,,

A_1 and A_2 were made with different portions of the same material; B with different material prepared in exactly the same way.

The substance, therefore, contained on an average 97.27 per cent. of silver. The nature of the residue would decide whether the material was silver with a certain amount of impurity firmly attached to it, or whether we had to do with silver in chemical combination with other elements.

The filtrate from the silver chloride in analysis A_2 was evaporated to dryness, and was found to contain chiefly iron and citric acid. The iron was thrown down as sulphide, redissolved in nitric acid, precipitated hot, washed with boiling water, and gave 0.8947. The residue, therefore, consisted of ferric oxide and citric acid, probably in the form of ferric citrate, and attached so strongly that even the very careful and prolonged washings given failed to remove them. Stronger means would be required than could be used without altering the condition of the substance. The conclusion, therefore, seemed to be justified that the material consisted of uncombined silver mixed simply with impurity.

To verify this conclusion by additional evidence, the substance was examined as to its behaviour when heated. For if any other element were chemically combined with the silver, it would only be (in view of the high percentage of silver) hydrogen or oxygen. We might have to do with a hydride, analogous to Wurtz's hydride of copper; or possibly an oxide; but not probably, as Ag_4O would contain only 96.43 per cent. of silver.

The presence of either hydrogen or oxygen in combination with silver seems to be pretty certainly negatived by the action of dilute sulphuric acid on this (and the other two substances, B and C, to be described farther on). They are all converted into grey metallic silver without the slightest escape of gas. This seems tolerably conclusive in itself, and the result of exposing a great number of specimens of all the forms A, B, and C to the action of heat was equally so. As the object was to expose the fresh and moist material to a gradually increasing heat, from that of boiling water to a low red heat, without interrupting the process, the following arrangement was found convenient:—

A piece of Bohemian glass tube about six inches long was sealed in the lamp at one end; the other closed with a rubber cork, through which passed a small gas delivery tube; and another tube passing into a small test tube partly filled with water, and having another tube through the cork passing under the surface of the water, thus preventing regurgitation. The material was thus first exposed for some hours to a heat of about 150° C. in a chloride of calcium bath; this was next removed, and the heat continued to low redness. Only traces of gas were evolved, and this was found to be, in all of the many trials made, carbonic acid, derived from the citric acid, adhering. This treatment was repeated many times with all the different varieties of the substance, and with the same result. The temperature was always raised sufficiently high to ensure the complete conversion of the material into normal grey silver, but in no case was oxygen or hydrogen set free.

It could not be overlooked that in all these trials the material had passed into an insoluble form before the silver determination was made. There remained, therefore, this possibility, that the silver, so long as soluble, might be in combination with citric acid, and that its change to the insoluble condition was caused by its separating from the citric acid. It seemed desirable that this view should be tested. As the object was to determine the condition of the silver in the substance, as originally formed, avoiding, as far as possible, to change that form by attempts at purification, the only course available was to determine the ratio between the silver on the one hand and the citric acid on the other, either excluding from the determination, or else removing, that portion of the citric acid which was combined with sodium (sodic citrate being used in excess) or with iron. The first attempt was to exclude without removing it, by using Wolcott Gibb's ingenious method of precipitating the base by hydrogen sulphide, and determining the acid thus set free in a solution originally neutral. It was ascertained by careful experiment on weighed quantities of pure anhydrous citric acid that exact filtration could be made with the aid of phenolphthalein. The silver was next redissolved and estimated as chloride. A large number of determinations were made, but the method proved unsatisfactory. It was found that portions of the same material operated upon separately gave different (even widely different) results. In fact, this very discordance was in itself a proof that no stoichiometrical combination existed between the silver and the citric acid.

The importance of the matter led me to take it up again with different means, estimating the citric acid by Creuse's method. In this method the solution, after being reduced to a small bulk, is exactly neutralised (with ammonia or citric acid), is tested with a slight excess of barium acetate, and then mixed with twice its bulk of ninety-five per cent. alcohol, let stand a day, and filtered and washed with sixty-five per cent. alcohol. In igniting, a few drops of sulphuric acid convert the barium salt into sulphate, in which form the estimation is made. A preliminary trial with a weighed quantity of citric acid showed that this method gave fairly good results. I was obliged to very the method somewhat; the precipitate of barium citrate carried down with it enough iron to render it ochrey in appearance. It was, therefore, after thorough washing with sixty-five per cent. alcohol till every trace of barium acetate was removed, dissolved on the filter with dilute hydrochloric acid (acid 1, water 10), in which barium citrate is extremely soluble, and washed through. This was followed by still weaker acid, and finally with water. From the filtrate, sulphuric acid precipitated snow-white barium sulphate.

But this method requires that both the sulphates and the excess of sodic and ferric citrate shall first have been perfectly removed. The blue precipitate was therefore washed with dilute solution of ammonic nitrate until this was effected. The necessity for this purification was regrettable as introducing a possibility of a change during the treatment. It was, however, indispensable that the ferrous, ferric, and sodic citrates should be got rid of. The material after this treatment was still freely soluble in water, to a dark-red solution. An examination of its absorption spectrum showed it to be still a true solution. From this solution the silver was first removed by H_2S, and then the citric acid was determined in the above described way. (If the silver were thrown down by hydrochloric acid, the reliability of the citric determination would be impaired.) Next, the silver sulphide was converted into chloride and weighed.

The result gave the ratio:—

1 gramme silver to .03195 gramme citric acid.

In this case, washing out the sulphates, etc., was an affair of several days. The work was repeated, reducing the time as much as possible. The material was precipitated, decanted as soon as settled, thrown upon a filter pump, and the funnel kept constantly full of ammonic nitrate in dilute solution by a wash bottle. By using very thick paper and a powerful pressure the entire washing was rapidly finished, so that in about six hours from first precipitation the material was thoroughly washed, redissolved, and again filtered, and placed under the action of H_2S. The result was—

1 gramme silver to .0130 citric acid.

When these relations are reduced from weights to equivalents, they become:—

No. 1. 1 equiv. citric acid to 55.63 equiv. silver.
No. 2. 1 equiv. citric acid to 193.7 equiv. silver.

indicating both that the proportion of citric acid present is variable, and that it is certainly not in stoichiometrical combination with the silver in the substance examined.

It has already been said that these solutions, before being acted upon by H_2S, were optically examined and found to be true solutions. The inference, therefore, seems to be very strong that there exists an allotropic form of silver freely soluble in water. This is a property so exceptional in a metal that I have admitted it with much hesitation. The principal arguments are as follows:—

The content of silver in the various products was very carefully, and I believe I may say, quite accurately, determined. It was extremely high, always above ninety-seven per cent. As already remarked, this virtually excludes the presence of all elements except hydrogen and, possibly, oxygen. These elements were carefully searched for; but their presence could not be detected. To suppose that we had to do with a mixture in which some compound of silver was mixed with metallic silver was not possible; for, as the whole was soluble, we should still have to admit the solubility of silver.

We have consequently to deal with a substance containing over ninety-seven per cent. of silver, and neither hydrogen nor oxygen in combination with it, the remaining two or three per cent. fully accounted for by ferric oxide and citric acid, determined as present as accidental impurity, the substance itself readily amalgamating with mercury by simple friction, nevertheless abundantly soluble in water. If I had been able to find any other explanation for these facts without admitting the solubility of silver I should have adopted it. But none presented itself.

Whether in solution it exists as a hydrate, that is, in more intimate combination with one or more equivalents of water, cannot be said with entire certainty; but the easy amalgamation with mercury seems hardly to favour that view. No means could be found for settling the question absolutely. Certainly at 100° C. all water is expelled, but this of course is not an argument. All the water is not expelled by indefinite exposure to a vacuum over sulphuric acid, but the proportion left is very small.

The material examined was in all cases as nearly as possible the same as that originally precipitated, but absolute identity could not be obtained. The purification absolutely necessary effects some change. This is shown by the colour. The freshly precipitated material dissolves to a blood-red liquid; by great dilution, yellowish red. The purified substance gives a darker red, which with dilution remains still red. Of the nature of the substances in the condition in which they were analysed I can speak with some positiveness, and these include a substance soluble in water and nevertheless appearing to be nearly pure silver.

The constitution of the lilac-blue substance at the moment of formation, and whilst under its mother water, is a matter of much more difficulty; it could not be said with certainty that it was not in some way altered in the purification. Much time and labour were spent in endeavouring to settle this point, without entirely satisfactory results, and I am at present engaged in the search for a better method.

When this blue soluble substance—purified either by washing very moderately by ammonium nitrate, or by washing with pure water, using those portions which remain undissolved after most has been carried through the filter—is brushed over paper and dried rapidly, it exhibits a very beautiful succession of colours. At the moment of applying it appears blood red; when half dry it has a splendid blue colour with a lustrous metallic reflection · when quite dry this metallic effect disappears, and the colour is matt blue. Examined with a polariser it shows the same characters as to two reflected beams of light polarised in planes perpendicular to each other that are described further on under B.

When the blue substance prepared in either way dries more slowly in lumps, the result is very variable: sometimes it is bright bluish metallic; sometimes dull lead colour, with a metallic reflection only where it has dried in contact with a smooth surface.

B.—INSOLUBLE FORM OF THE FOREGOING.

The solution of the blue product just described is influenced in a remarkable way by the addition of almost any neutral substance. So far I have not found any that do not precipitate it. Not only saline solutions do this, but even a solution of gum arabic.

Neutral salts may precipitate the silver in either a soluble or an insoluble form. Alkaline sulphates, nitrates, and citrates throw down the soluble form; magnesium sulphate, ferrous sulphate, nickel sulphate, potassium bichromate and ferrocyanide, barium nitrate, even silver nitrate and other salts, throw down a perfectly insoluble form. The soluble form constitutes a blue or bluish-black precipitate; the insoluble a purple brown, which by repeated washing, by decantation, or otherwise, continually darkens.

What is very curious is that the insoluble form may be made to return to the soluble condition. Many substances are capable of effecting this change. Sodium borate does so, producing a brown solution; potassium and sodium sulphate produce a yellowish red solution, and ammonium sulphate a red one. None of these solutions have the same blood-red colour as the original solution: the form of silver seems to change with the slightest change of condition.

The solutions used must be extremely dilute, otherwise the silver, though rendered soluble in pure water by them, will not dissolve in the solution itself, a singular complication of effects. So that if a moderately strong solution of one of the above substances is poured over the insoluble silver substance it does not dissolve; but by pouring off the saline solution and replacing it with pure water the substance dissolves readily. The insoluble substance is also readily soluble in ammonia. The solution has a fine red colour, and not the yellowish red of the sodium sulphate solution.

Most neutral salts act in one or other of the ways just described, precipitating the solution of the blue substance, A, in either the soluble or the insoluble form, the latter soluble in ammonia. But sodium nitrate is an exception; its solution effects an entire change, and renders the substance wholly insoluble, probably reconverting it into normal silver.

Sometimes the substance will spontaneously pass into a soluble form. A specimen, rendered insoluble by precipitation with ferrous sulphate, after much washing began to run through, not only as a suspension, which often happens, but as a solution, clearing itself after a day or two of insoluble portions, and furnishing a rose-red solution. I have kept this solution in a corked vial for eight months, during which time it has remained unchanged.

The general properties of this substance can be much better observed in the thin films obtained by brushing the moist substance over paper than in the lumps. The films thus obtained are bright greenish metallic, and this green evidently results from a mixture of blue and yellow, as in some lights the blue, in others the yellow, is most evident. When these films are examined by light reflected from them at a large incidence with the normal, and a Nicol's prism or an achromatised prism of calc spar is interposed between the film and the eye, it becomes at once apparent that the blue and yellow light are oppositely polarised. The yellow light is polarised in the plane of incidence, the blue light perpendicularly to that plane. All specimens show the yellow light; but the quantity of blue light is very variable, and is directly connected with the amount of washing applied to the precipitate. The more it is washed, the more the yellow predominates. To see the blue form in its full beauty, a little of the red solution may be precipitated with a very little magnesium or aluminic sulphate, and be thrown on a filter. As soon as the liquid has drained off, and without any washing, the deep bronze-coloured substance is to be brushed over paper. On drying, it has all the appearance of a bright blue metal with a remarkable lustre. The mirrors obtained by brushing the substance over glass are so beautiful and so perfect that it seems as if this property might have useful applications, especially for silvering irregular surfaces. Much care, however, would be necessary in the preparation to obtain a permanent product.

Crystallisation.—On one occasion this substance was obtained in a crystalline form. Some crude red solution had been set aside in a corked vial. Some weeks after, it was noticed that the solution had become decolourised, with a crystalline deposit at the bottom. The bottle was carefully broken; the deposit, examined by a lens, consisted of short black needles and thin prisms. Evidently the saline matters present had balanced the silver in solution so nearly as not to cause an immediate precipitation, but a very gradual one only. The mother liquor was drained off, and a few drops of pure water added. No solution took place; the crystals were, therefore, of the material B, the insoluble form. The contact of pure water instantly destroyed the crystallisation, and the substance dried with a bright green metallic lustre. Contact with pure water evidently tends always to bring this form of silver into the colloidal state, sometimes soluble and sometimes not; whilst the contact with certain neutral salts renders it crystalline.

The extraordinary sensitiveness which allotropic silver shows to external influences contrasts strongly with the inertness of normal (probably polymeric) metallic silver. When we place this fact alongside of the well-known sensitiveness of many silver compounds to light, heat, and (as I have elsewhere shown) to mechanical force, we are led to ask whether silver may not exist in this form in these very sensitive compounds.

To obtain the substance in a pure condition suitable for analysis, it is necessary to choose a precipitant not giving an insoluble product with either citric or sulphuric acid. Magnesium sulphate or nickel sulphate answers well; I have generally used the first named. A very dilute solution is made of it, and the red solution of A is to be filtered into it. The precipitate soon subsides. A large quantity of water is to be poured on, and then washing by decantation can be continued to three decantations, after which the substance remains suspended. It can be made to subside by adding a very small quantity of magnesium sulphate; one four-thousandth (0.25 gramme to one litre) is sufficient. The substance may then be thrown on a filter and washed with pure water.

Analysis.—A specimen dried in vacuo over sulphuric acid gave:—

No. 1 .... 97.17 per cent. silver
No. 2 .... 97.10 per cent. silver

A specimen dried first in vacuo, and then at 100° C., lost in the second drying 0.88 per cent. water.

So that the substance dried at 100° contained 97.96 per cent. of silver. The remaining 2.04 per cent. consisted of ferric oxide and citric acid.

C.—GOLD-YELLOW AND COPPER-COLOURED SILVER

It has long been known that golden-yellow specks would occasionally show themselves in silver solutions, but could not be obtained at will, and the quantity thus appearing was infinitesimal. Probably this phenomenon has often led to a supposition that silver might be transmuted into gold.[1] This yellow product, however, is only an allotropic form of silver; but it has all the colour and brilliancy of gold, a fact which was apparent even in the minute specks hitherto obtained.

By the means presently to be described, silver can be converted wholly into this form. It is a little curious that its permanency seems to depend entirely on details in the mode of formation. I have found many ways of obtaining it, but in a few months the specimens preserved changed spontaneously into normal silver. This happened even in closed tubes. The normal silver produced in this way is exquisitely beautiful. It has a pure and perfect white colour like the finest frosted jeweller's silver, almost, in fact, exceeding the jeweller's finest products. I found, however, one process by which a quite permanent result would be obtained. Specimens made by it in November of 1886 were, at the end of thirty months, unchanged.

In forming the blue product which I have called A, very concentrated solutions were necessary. C, on the contrary, is best obtained from very dilute ones. The following proportions give good results:—

Two mixtures are to be prepared. No. 1 containing 200 c. c. of a ten per cent. solution of silver nitrate, 200 c. c. of a twenty per cent. solution of Rochelle salt, and 800 c. c. of distilled water.

No. 2, containing 107 c. c. of a thirty per cent. solution of ferrous sulphate, 200 c. c. of a twenty per cent. solution of Rochelle salt, and 800 c. c. of distilled water.

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[1] I have a little volume, published in Paris in 1857, by a chemist named Tiffereau, who was firmly convinced that in many reactions minute portions of silver are converted into gold, especially with the aid of powerful sunlight. In Mexico, he affirmed, he had artificially produced several grammes of gold, a portion of which he presented to the French Academy with one of his papers. To his great disappointment he did not succeed in repeating these experiments in Paris with more than an infinitesimal result. All gold, in his opinion, had been originally silver; and this belief, he affirms, is universal amongst Mexican miners. The book has for a title, "Les Métaux sont des Corps composés."

The second solution (which must be mixed immediately before using only) is poured into the first with constant stirring. A powder, at first glittering red, then changing to black, falls, which on the filter has a beautiful bronze appearance. After washing, it should be removed, whilst in a pasty condition, and spread over watch glasses or flat glass basins, and allowed to dry spontaneously. It will be seen that this is a reduction of silver tartrate by ferrous tartrate. The metallic silver formed by reduction with ferrous citrate and ferrous tartrate is in an allotropic condition; with ferrous oxalate this result does not seem to be produced.

Although the gold-coloured silver (into which the nitrate used is wholly converted) is very permanent when dry, it is less so when wet. In washing, the filter must be kept always full of water; this is essential. It dries into lumps exactly resembling metallic gold, especially the surfaces that have dried in contact with glass or porcelain. For this substance has in a high degree the property already described in forms A and B—that of drying with the particles in optical contact. When the thick pasty substance is extended over glazed paper, it dries with the splendid lustre of gold leaf, with this essential difference, that these allotropic forms of silver, B and C, assume spontaneously in drying the high degree of brilliancy which other metallic surfaces acquire by elaborate polishing and burnishing. By brushing a thick paste of this substance evenly on clean glass, beautiful gold-coloured mirrors are obtained; the film appears to be entirely continuous and the mirror is very perfect.

By continued washing the precipitate changes somewhat, so that in drying it takes on a coppery rather than a golden colour, and is rather less lustrous, though still bright and permanent.

Two silver determinations by conversion into chloride made in November, 1886, gave:—

No. 1	97.81 per cent. silver.
No. 2	97.86 per cent. silver.

Recently these experiments have been repeated, and the washing was more successful. Ferric tartrate adheres very obstinately, and after a time washing with water ceases to remove it. Stronger means cannot be employed without affecting the substance itself. These last determinations gave:—

No. 1	98.750 per cent. silver
No. 2	98.749 per cent. silver

The residue of No. 2 was examined, and consisted almost wholly of ferric citrate.

The two insoluble forms of allotropic silver which I have described as B and C (B, bluish green; C, rich golden colour) show the following curious reaction. A film of B spread on glass and heated in a water stove to 100° C. for a few minutes becomes superficially bright yellow; a similar film of the gold-coloured substance C, treated, in the same way, acquires a blue bloom. In both cases it is the surface only that changes.

Sensitiveness to Light.—All these forms of silver are acted upon by light. A and B acquire a brownish tinge by some hours' exposure to sunlight. With C the case is quite different, the colour changes from that of red gold to that of pure yellow gold. The experiment is an interesting one, the exposed portion retains its full metallic brilliancy, giving an additional proof that the colour depends upon molecular arrangement, and this with the allotropic forms of silver is subject to change from almost any influence.

Stability.—These substances vary greatly in stability under influences difficult to appreciate. I have two specimens of the gold-yellow substance C, both made in December, 1886, with the same proportions under the same conditions. One has passed to dazzling white, normal silver, without falling to powder or undergoing disaggregation of any sort, the fragments have retained their shape, simply changing to a pure frosted white, remaining apparently as solid as before; the other is unchanged, and still shows its deep yellow colour and golden lustre. Another specimen, made within a few months and supposed to be permanent, has changed to brown. Complete exclusion of air and light is certainly favourable to permanence.

Physical Condition.—The brittleness of the substances B and C, the facility with which they can be reduced to the finest powder, makes a striking point of difference between allotropic and normal silver. It is probable that normal silver, precipitated in fine powder and set aside moist to dry gradually, may cohere into brittle lumps, but these would be mere aggregations of discontinuous material. With allotropic silver the case is very different, the particles dry in optical contact with each other, the surfaces are brilliant, and the material evidently continuous. That this should be brittle indicates a totally different state of molecular constitution from that of normal silver.

Specific Gravities.—The allotropic forms of silver show a lower specific gravity than that of normal silver.

In determining the specific gravities it was found essential to keep the specific gravity bottle, after placing the material in it, for some hours under the bell of an air-pump. Films of air attach themselves obstinately to the surfaces and escape but slowly even in vacuo.

Taken with this precaution, the blue substance B gave specific gravity 9.58, and the yellow substance C, sp. gr. 8.51. The specific gravity of normal silver after melting was found by G. Rose to be 10.5. That of finely-divided silver obtained by precipitation is stated to be 10.62.[2]

I believe these determinations to be exact for the specimens employed. But the condition of aggregation may not improbably vary somewhat in different specimens. It seems, however, clear that these forms of silver have a lower specific gravity than the normal, and this is what would be expected.

It was mentioned previously that the red gold-coloured modification of silver was converted into a bright yellow-coloured form by the action of light. Continued exposure seems to produce little further change so long as the substance is dry. But if the paper on which the silver is extended is kept moist by a wet pad, with three or four days of good sunshine, the change goes on until the silver becomes perfectly white and is apparently changed to normal silver;[3] water, alone, tends to darken this form of allotropic silver, accordingly the portion of the paper that was protected for comparison, darkened, showing that the whitening effect was due wholly to light.

It thus appears that light can convert yellow or red-yellow allotropic silver to white.

Some pieces of the very bright blue-green modification were exposed to light, and with about one day's bright sunshine they passed to a pure metallic gold colour.

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[2] Watts' Dict., original edition, V. p. 227.

[3] The pad used was of unbleached muslin, which was boiled several times with distilled water to remove everything soluble before use.

It appears, therefore, that light can cause the blue-green modification to pass to the golden-yellow.

This change only occurs with a very brilliant form of the bluish-green substance, which is obtained with a quick, short washing. Specimens slowly and very thoroughly washed, which when brushed over paper gave a more matt colour, did not yield this result, but became brownish. Nor can this result be obtained with the soluble form of allotropic silver described.

Light, therefore, can change the bluish-green to the yellow modification, and this last (with the aid of moisture) to white normal silver. The silver thus obtained is pure white, lustrous, and metallic, resembling silver leaf. Organic compounds of silver reduced by light give grey or black silver devoid of lustre.

The three forms of allotropic silver—the blue soluble and the blue and the yellow insoluble—are not to be understood as the only forms which exist, but as the best-marked only. The substance is protean, and exhibits other modifications not yet studied. No other metal than silver appears to be capable of assuming such a remarkable variety of appearances. Every colour is represented. I have obtained metallic silver, blue, green (many shades of both) red, yellow, and purple. In enumerating these colours I do not refer to interference colours produced superficially by reagents, also wonderfully brilliant, but to body colours. As a single instance of colouration the following may be mentioned. I recently obtained a solution of allotropic silver of an intense yellow-brown. A little solution of disodic phosphate changed this to bright scarlet (like Biberich scarlet), presently decolourising with formation of a purple precipitate. Washed on a filter this changed to bluish-green. The colours I have met with in this investigation can only be compared with the coal-tar products, of which one is constantly reminded by their vividness and intense colorific power.

Two of the insoluble forms of allotropic silver, the gold-coloured and the blue, show in many respects a close relationship and almost identical reactions. There are other respects in which they differ strikingly, and amongst these instability. Blue allotropic silver (dark red whilst moist, becoming blue in drying) is very stable. It may be exposed for weeks in a moist state on a filter, or be placed in a pasty condition in a corked vial, and so kept moist for months without alteration.

The gold-coloured form, on the contrary, tends constantly to revert to ordinary silver. This is especially the case whilst it is moist, so that from the time of its formation it must be separated from its mother water, and washed as rapidly as possible, otherwise it loses its brilliancy and purity of colour, and changes to a dark, dull, grey form of normal silver. On the filter its proper colour is pure black, with a sort of yellow shimmer (the gold colour appearing as it dries); often, especially if allowed to become uncovered by the water during washing, it will change superficially to grey.[4] But if the washing is done rapidly, with the aid of a filter pump and a pressure of four or five inches of mercury, the allotropic silver obtained, when allowed to dry in lumps, or brushed over paper or glass, is at least equal to pure gold in colour and in brilliancy. With the blue powder such precautions are wholly superfluous.

Of the facility with which the gold-coloured form is converted into normal silver, I have recently had a somewhat singular proof. I brought with me to my summer home a number of specimens in tubes, some recently prepared, some dating back as far as ten and a half years, together with other tubes containing specimens of white silver spontaneously formed from the gold-coloured. On opening the box no tubes of gold-coloured silver were to be found; all had changed to white. But the same box contained pieces of paper and of glass on which the same material had been extended; these were wholly unchanged, and had preserved the gold colour perfectly. Apparently the explanation was this—the mere vibration caused by the jarring of a journey of six hundred miles by rail and steamboat had had no effect in changing the molecular form, but the material contained in the partly filled tubes had been also subjected to friction of pieces moved over each other, and this had caused the change. To verify this explanation I prepared fresh material, filled three similar tubes, each one-quarter full, but in one forced in cotton wool very tightly to prevent frictional motion. These tubes were packed in a small box and sent over two thousand four hundred miles of railway. The tubes with loose material came back much altered. One was nearly white, and, as the change had been set up, will probably in a few years be entirely so;[5] another with loose material was also changed, but not as much as the first mentioned. The tube filled up with cotton came back unaltered, so that continued friction of pieces sliding over each other will cause a change to take place in a few days, which otherwise might have required years, or might not have occurred at all. The permanency of this substance is greatly influenced by moisture, so that when simply air-dried before placing it in tubes it is less permanent than when dried at 70° or 80° C. in a stove. Tubes placed in the same box containing the blue form remained unaffected by the motion, though only partly filled and allowed to move freely.

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[4] When well washed, this form can also be preserved, for a time, in the moist condition in a corked vial, as I have lately found.

When gold-coloured allotropic silver is gently heated in a test tube it undergoes a remarkable change in cohesion. Before heating, it is brittle and easily reduced to fine powder. After heating, it has greatly increased in toughness, and cannot be pulverised at all.

Both the gold-yellow and the blue forms resemble normal silver in disengaging oxygen from hydrogen peroxide. These two forms, though differing so much in colour and stability, and differing also in specific gravity and in their mode of formation, have many properties in common not possessed by ordinary silver, and differentiating them strongly from it. They show a vastly greater sensitiveness to reagents, and are also sensitive to light. The ability to form perfect metallic mirrors by being simply brushed in the pasty condition over glass has been mentioned.

Many substances which react little, if at all, with ordinary silver, attack the gold-coloured and the blue allotropic silver, with production of very beautiful colours due to the formation of thin films and resulting interference of two reflected rays. In my previous papers I called this the "halogen reaction," because first obtained by the action of substances which easily parted with a halogen. But I have since found that many other reagents will produce the same or similar effects. These are:—

Sulphides.—Paper brushed over with either the gold, the copper-coloured, or the bluish-green substance exposed to the vapour of ammonium sulphide, or immersed in a dilute solution of it, assumes beautiful hues, though less brilliant than those obtained in some other ways.

Potassium Permanganate in dilute solutions produces blue, red, and green colours.

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[5] Had since become so.

Potassium Ferricyanide in moderately strong solution gradually attacks allotropic silver with production of splendid blue, purple, and green colouration.

Phosphorous Acid produces gradually a rather dull colouration.

The colour reaction is produced finely by substances which readily part with a halogen—such as ferric and cupric chlorides, sodium hypochlorite, hydrochloric acid to which potassium bichromate has been added—and by corresponding bromine and iodine compounds. In some earlier experiments I obtained effects of the same sort, but in much weaker degree, with alkaline haloids. But with purer products the results have been different. There is at first some darkening, but no true colour reaction, and the allotropic silver appears to be gradually converted into normal, so that it is no longer capable of giving the brilliant colour reaction with potassium ferrid-cyanide, but, like normal silver, takes a pale and faint colouration only.

ON PERSPECTIVE AND DEPTH OF FIELD, WITH SPECIAL REFERENCE TO SHORT-FOCUS LENSES.

[A paper read before the Oxford meeting of the Photographic Convention of the United Kingdom.]

I CHOOSE to treat perspective and depth of definition because these two qualities are closely connected with the general problem of photographic delineation; to represent solid (three-dimensional) objects on a plane (two-dimensional) surface. Every one of us will have read in some catalogue or other that the optician cannot correct his objectives for depth of focus, and that he cannot be held responsible for exaggerated perspective, if his customer uses a short-focus lens for taking a portrait on a comparatively great scale; when I take up this subject to-day, I wish to show that perspective and depth of definition are settled before the rays even enter the lens.

We will proceed according to Professr Abbe's theory, as far as it deals with the function of diaphragms, and I will begin by treating photographic perspective.

Let us first take the simple case of a pin-hole camera, and suppose that we obtain pictures with it, wherever we place the ground glass (fig. 1). If we now consider the representation of these two posts, P_1 and P_2, on the ground glass, we notice that their images p_1 and p_2 bear a certain relation to each other, say $p_2 : p_1 = 5 : 10$. By altering the position of the focussing screen the image may be enlarged or diminished in size; but the relation of the two images (say 2 $p_2 = p_1$) remains obviously the

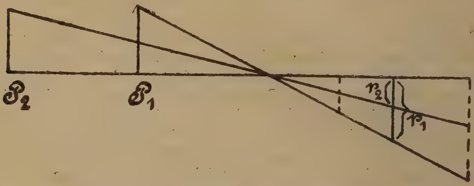

FIG. 1.

same. In order to alter this relation, we have to alter the distance of the pin-hole. From the drawings, you may easily infer that this relation decreases $p_2 : p_1 = 4 : 10$ for a shorter (as in fig. 2), and increases $p_2 : p_1 = 6 : 10$ for a greater distance of the stop from the object (as in fig. 3).

Proceeding now to the more complicated case of a photographic objective, we will first assume that it is stopped down rather much, say to f-40 or f-50 (fig. 4), so that a great range of objects will appear sufficiently sharp on the ground glass in F if we focus for P_1. The post P_2 will also be defined sufficiently sharp, and the whole image will at the same time appear much brighter than in the former case of the pin-hole camera. But one important difference is to be observed against our former case: we are restricted to a certain definite distance, say O F, in other words, we have one definite scale of reduction only of the objects in focus, and that is given by the well-known formulæ connecting the position of the image with the position of the object and the local length of the lens. To find out the law according to which the lengths of the different objects not in focus are reduced on the matted surface, or, in other words, to find out the perspective for the delineation on the ground glass, we look for the object conjugate to this drawing appearing on the focussing screen. Although the objects are represented thereon, they are obviously not themselves conjugate to it, because their sharp images cannot possibly lie in one and the same plane conjugate to the ground glass, and as the delineation here is formed by the intersection of certain rays after their passage through the objective, we must

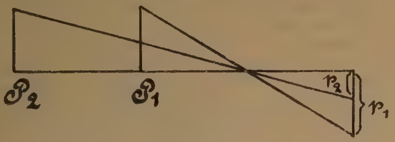

FIG. 2.

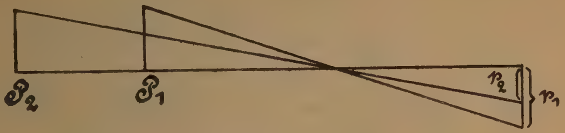

FIG. 3.

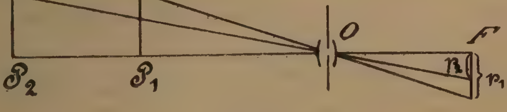

FIG. 4.

look for their intersection with the conjugate object plane before they enter the lens.

We will now first consider the way of the rays in front of the lens (the conjugate rays), and then find out the conjugate object plane. As our objective was stopped down considerably, we may exhibit the whole pencil emitted from any object point by one representative ray, passing through the middle of the diaphragm. In order to obtain a clearer idea of the course of said ray, we detach for a moment the front lens of our objective together with the small diaphragm (fig. 5).

Supposing a bright object (polished pin's head) in the place of the diaphragm, the rays passing from it through the lens undergo the collective action of the lens as shown and an eye placed in front of the lens will perceive the virtual image (of the pin's head) or of the diaphragm at a certain distance behind the lens. Rays travelling in the direction shown, before the objective, and these only, meet after refraction exactly in the diaphragm. According to Professor Abbe's appellation, we will call this image the Entrance Pupil.

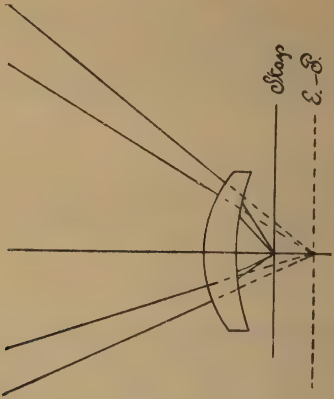

Fig. 5.

Returning now to our objective, we may assert that every point on the side of the objects visible from the place of the lens, within the limits of the embraced angle, will determine a ray pointing to the entrance pupil, and passing through the objective; for the whole object side the entrance pupil evidently serves as the centre of perspective. Directing now our attention to the conjugate plane, we remember, looking at fig 4, our supposition of the objective being focussed for P_1. For lenses free from astigmatism and showing a flat field as modern lenses do, the whole plane drawn through post P_1, perpendicularly to the axis is conjugate to the ground glass, and any point on this plane will appear sharp on the ground glass.

Having now ascertained the conjugate rays as the entire variety of rays aiming at the centre of the entrance pupil, and the conjugate plane as the "plane focussed for" (pl. f.f.) we have only to find the intersection of these rays with the said plane; in other words, if, after determining the pl. f.f., we project it on every object point from the centre of the entrance pupil we obtain the real object, the image of which appears in n-fold reduction on the ground glass. Now we clearly see the whole part the objective plays as regards perspective, given the object and the centre of the entrance pupil and determined the pl. f.f. (it generally passes through the chief parts of the objects and is therefore in Mr. T. R. Dallmeyer's treatise[1] designated as the chief object plane); the whole perspective is also determined, so that the only thing left to the objective is the linear scale of reduction.

In viewing any perspective delineation one has to be careful how to select the correct distance between the eye and the picture. We obtain this distance by applying the same reduction to the distance between entrance pupil and pl. f.f. as exists between the delineation on the pl. f.f. and the image. (If we photograph a bust from a distance of 12 feet at a quarter natural size, the correct viewing distance from the photograph is 3 feet.) If the correct distance be always observed (fig. 6), we get the same impression when viewing the photograph as the objects depicted on it represented themselves to the eye at the place of the entrance pupil of the objective, and this is unquestionably the correct impression.[2]

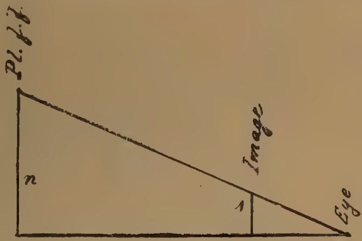

FIG. 6.

In accordance with this rule it is advisable, by looking at the object itself, first to determine the centre of perspective; one will then invariably obtain a pleasant impression when inspecting the photograph from the right distance. But if, on the contrary, the size of the objects in the image is our principal aim, it will, in the case of short-focus lenses, become necessary to reduce the distance between object and lens, thereby altering the perspective. In extreme cases, i.e., in mis-using short-focus lenses, we may be compelled to advance too close to the object, and to take a photograph from a standpoint totally unusual for ordinary contemplation; in such a case the picture, notwithstanding its perfect correctness, will appear unpleasant, even if it be viewed from the proper distance. Summing up, we may say perspective is a function merely of the distance between pl. f.f. and the entrance pupil; the objective has nothing to do with it; the only part it plays consists in reproducing the delineation of the pl. f.f. in a certain reduction. If the photograph be viewed from the correct distance, it must necessarily convey the right impression. The only thing to be observed from a pictorial point of view is with regard to the selection of the standpoint; to avoid an unpleasant impression, the distance between pl. f.f. and entrance pupil must not be smaller than the ordinary viewing distance of the objects photographed.

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[1] "Tele-photography," p. 95. London: Heinemann, 1899.

[2] There may, however, arise a difficulty from the fact that the proper viewing distance lies within the least distance of distinct vision, being less than 10 inches. In this case, the picture must be inspected by means of a magnifier, or we have to substitute a copy so enlarged that the proper viewing distance comes up to 10 inches.

The foregoing considerations on perspective remain correct also in the case of objectives with large apertures. Every photographer will be aware that the different points on the focussing screen of a stopped-down objective representing object points in front of or behind the pl. f.f. do not alter their position if the iris is opened, but only appear more and more indistinct. Therefore, everything belonging to the perspective of a photograph remains unaltered.

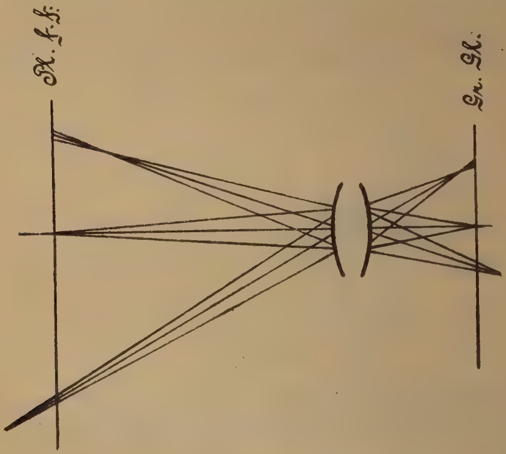

FIG. 7.

The reason for this blurring is not difficult to give. It is founded on the fact that objects at different distances in front of the lens are rendered sharp at different distances behind it (fig. 7). So the cone of rays emitted behind the pl. f.f. is brought to a union in front of the ground glass and on this plane shows a spot or circle of confusion instead of a point, and likewise for a cone of rays emanating from a point in front of the pl. f.f. From this drawing the reason becomes evident why in a modern rapid objective the image on the ground glass is composed of sharp points for objects lying in the pl. f.f. and of smaller or larger spots belonging to points at shorter or longer distances from the pl. f.f. As in the former case when discussing perspective, it will here also simplify matters to find out the object conjugate to the delineation on the ground glass. Being aware of the connexion between focussing screen and pl. f.f., we have only to look for the intersections between pl. f.f. and the cone of rays in front of the lens. From a similar consideration as in the former case of the small stop it is equally evident (fig. 8) for a large stop that only such pencils pass the diaphragm after collection through the front lens which are directed originally towards the entrance pupil.

The common basis of all the pencils coming from the object side and passing through the lens is, therefore, the entrance pupil. Consequently we obtain at once the conjugate object looked for, by projecting every object point within the angle of the objective on the pl. f.f. by means of a cone having its apex in the point and its basis in the entrance pupil. By this method, founded on Professor Abbe's theory of the entrance pupil, we get rid of the action of the objective altogether so far as depth of definition is concerned; in other words, we consider the depth of definition question in the case of an ideal lens giving a perfect reduced image of the delineation constructed on the pl. f.f. The indistinctness present in this case has nothing whatever to do with the state of correction of the objective, the type of construction, etc. It is the consequence of the fact that an object of three dimensions is to be projected on one plane by means of pencils of definite aperture. The whole problem is definitely fixed when pl. f.f., distance, and diameter of the entrance pupil are given.

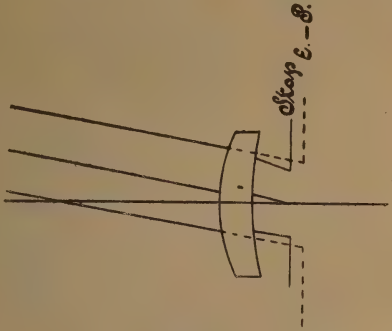

Fig. 8.

The above-mentioned indistinctness presenting itself very remarkably, the interest of photographers was intently fixed on it, and in the very first photographic time the idea was maintained that different objectives possessed this fault, as it was called, in a different degree, and principally the difference observed in long and short-focus lenses awakened interest. The question put in such a case—as far as I am aware—is generally the following: given for a system with given aperture a certain object distance or scale of reduction, which is the depth of definition (sometimes also called depth of field or inadvertently depth of focus), if a circle of indistinctness of 0.01 in. is allowed? In this question—it is true—everything is distinctly stated, but we are far from treating photographs taken with systems of different focal lengths alike. An example will clearly show it; supposing two photographs representing the same object taken with two lenses of different focal length from the same standpoint and under the same standard of indistinctness (0.01 n.), then nearly always the depth of definition in the smaller photograph is greater. Now, it may be necessary to project these photographs (or congruent diapositives) on the screen, and, in order to obtain the same convenient size of objects in both cases, the larger may have to be magnified 20, the smaller 40 times. We immediately see that by giving different linear magnifications to these two diapositives, the depth of definition will diminish for the smaller, because the same circle of indistinctness is magnified twice as much in one case as in the other. It is not difficult to give the reason for it in our way of contemplating the subject. We are aware of the fact that we obtain every dimension in the pl. f.f. by multiplying the conjugate image dimension by the scale of reduction. This naturally applies to the circle of indistinctness as well; consequently admitting the same circle of indistinctness of 0.01 in. to a photo reduced 200 times, as to a picture reduced 400 times, we admit in the first instance on the pl. f.f. spots of 2 inches diameter, and of 4 inches in the second case. Although the photographs taken from the same standpoint show exactly the same perspective, quite different standards are applied to distinctness in pl. f.f.

I think we could find a way out of this difficulty by going back to the meaning of distinctness of vision. In consequence of the construction of our eyes, we are not able to distinguish a perfectly sharp point from a spot appearing under a certain small angle generally taken as 1′.[1] The diameter of the spot passing as a point is therefore dependent upon its distance, and may be considered, according to the old theory $\frac{1}{3438}$ of this distance, or one inch for every 286-5 feet. If we allow on the pl. f.f. such circles of confusion only which subtend no greater angle than 1′, the delineation on the pl. f.f. will appear perfectly sharp to an eye at the plane of the entrance pupil. In the same manner we may call the conjugate photograph perfectly sharp if we view it from the correct distance, for obviously in this case (see fig. 6) the angular measure (1′) remains unaltered because object and viewing distance undergo the same reduction. One sees immediately that for photographs taken with short-focus lenses the diameter of the circle of confusion in the image becomes smaller than with long-focus objectives, because the viewing distance decreases in the same ratio as the reduction increases. Such pictures, however, can be subsequently magnified to the size of images taken with larger lenses from the same standpoint, and they will then prove equal, taking exception of the deterioration connected with the process of magnification. I may mention here that it is obviously unnecessary to fix the angular standard of distinctness at 1′; every multiple will do as well if for scientific or artistic purposes a higher or lower standard seems desirable. The ordinary standard of 0.01 inch in the photograph corresponds—the distance of distinct vision being taken as ten inches—to 3′ 26″, or the 3.4-fold amount of the former. But, whatever standard we may use, it seems advisable to employ the angular and not the linear measure.

We are now in the position to answer the following question: Supposing angular indistinctness and perspective remaining constant, is there any advantage as regards greater rapidity together with the same depth of field in using short-focus lenses with the object of subsequent enlargement of the image? According to our way of treating this question there are given the pl. f.f., and together with the distance of the entrance pupil, the diameter of the circle of confusion in the pl. f.f. For any size of the entrance pupil we may very easily determine the depth of definition (fig. 9). Let the circle of confusion in the pl. f.f. be represented by C C, then it is only necessary to draw straight lines from both points representing the entrance pupil to each point C. By this means two points, D D_1, are defined and, as one immediately sees, D D_1 is the required depth of definition consistent with the given distance between pl. f.f. and entrance pupil, the size of the latter, and the given angular value of indistinctness. Any objective at the place of the entrance pupil, and with an entrance pupil of the same size, has exactly this same depth of definition, D D_1. Now, as the intensity increases with the square of the diminution of the focal length, the size of the opening remaining constant, the advantage of short-focus lenses is apparent. Assuming two objectives, one of half the focal length of the other, the shorter one will give in a quarter of the time a picture which, by subsequent enlargement, may be made congruent to that of the longer.

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[1] According to the old theory this angle was taken as 1′ for normal eyes; from more recent investigations we know that now and again people are found able to distinguish much finer detail; even $\frac{1}{6}$ of the normal standard (10″) sometimes occurs.

The other question of interest presenting itself is the following: How great is the advantage of the short-focus lens as regards depth of field, perspective and relative aperture being constant? This cannot be answered in so general a manner as the preceding question, the advantage somewhat varies according to the general formula for the depth *t* depending upon the distance *d* (between pl. f.f. and entrance pupil), the size of the entrance pupil *a*, and the indistinctness *ni* in the pl. f.f.

$$t = \frac{2d\,ni\,a}{a^2 - n^2i^2}\,[1]$$

To illustrate this formula to those not versed in such calculations I choose a certain fixed distance of 2 *m* (6 ft. 6.7 in.) and gave for two objectives of 140 mm. (5½ in.) and 210 mm. (8¼ in.) focal length, the connection between depth of definition on one side and size of entrance pupil and distinctness on the other side by means of diagrams (figs. 10, 11). I connected all the points where the depth of definition was equal to certain fixed lengths from 1 to 12 inches. The axes of the diagram are divided twofold: the horizontal according to the numbers of millimetres giving the size of the entrance pupil, and underneath this size as part of the equivalent focal length, the vertical axis according to the indistinctness in the image *i* and according to the indistinctness *ni* in the pl. f.f. (We know for a fair comparison this latter value must be taken.) Metric measurements are employed in consequence of their decimal sub division; in the lines of equal depth of definition, however, inches (with the approximate value of 25 mm. instead of 25.4 mm. to an inch) could be

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[1] For anybody interested in inquiries of this kind, I may remark that by dividing numerator and denominator by a^2 and defining the auxiliary angle $\frac{w}{2}$ by

$$\tan\frac{w}{2} = \frac{ni}{a}$$

the formula becomes,

$$\frac{t}{d} = \frac{2\tan\frac{w}{2}}{1 - \tan^2\frac{w}{2}} = \tan w$$

by these formulæ anybody accustomed to tables of logarithms will be able to find very soon any of the four quantities *t*, *d*, *ni*, *a*, if the other three are given. Generally a table with four decimals will amply suffice for our aim.

ascribed. Looking at the diagrams one immediately notices that the curves of equal depth of definition become straight lines emanating from the origin. This has the consequence of a very convenient construction of these lines, and furthermore the connection of a constant depth of definition with indistinctness and diameter of the entrance pupil becomes evident. I may at the same time point out that only by introducing the linear measure of the entrance pupil, the diagram becomes so simple, whereas by dividing the horizontal axis according to relative apertures (*f*-10, *f*-15, *f*-20, etc.), in equal intervals we should obtain a kind of hyperbolic curve. The reason for this lies in the fact pointed out before that the whole projection by means of which the delineation on the pl. f.f. was obtained is quite independent of the focal length of the lens. With regard to perspective and depth of definition, the photographic objective plays only a part of secondary importance in reproducing an ideal but

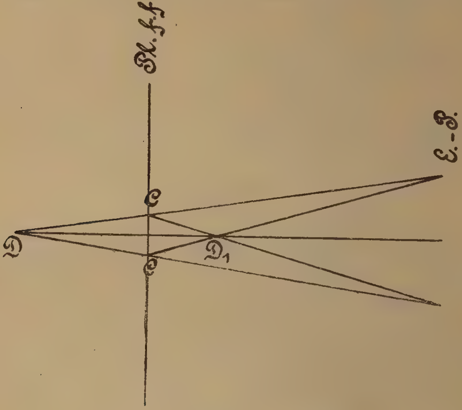

FIG. 9.

nevertheless perfectly determined plane object on a certain scale of reduction.

It will not be difficult to gather from these diagrams a corroboration of our previous statement. Assuming, for instance, $ni=0.85$ mm., we have for $f=210$ mm. (8¼ in.), a depth of definition of 2 in. for a—68 mm. or *f*-3.09; whereas for *f*-140 mm. (5½ in.), we obtain $ni=0.85$ and depth of definition=2 in. for the same $a=68$ mm. or *f*-2.06. If we now stop down the smaller lens to *f*-3.09 or $a=45.3$ mm., the depth of definition for $ni=0.85$ mm. becomes 3 in. or it varies inversely as the focal length. This is always the case so long as the diameter a is great in comparison with ni; if a and ni are quantities of the same order, the depth of definition of the smaller objective increases much faster than in the inverse ratio, but in this case one must go back to the formula.

From the preceding paper we are entitled to the following conclusions: small lenses show no disadvantage compared with large ones, as far as perspective is concerned, if the photograph is taken from a sufficient distance and a suitable magnifier or (magnification) is provided to look

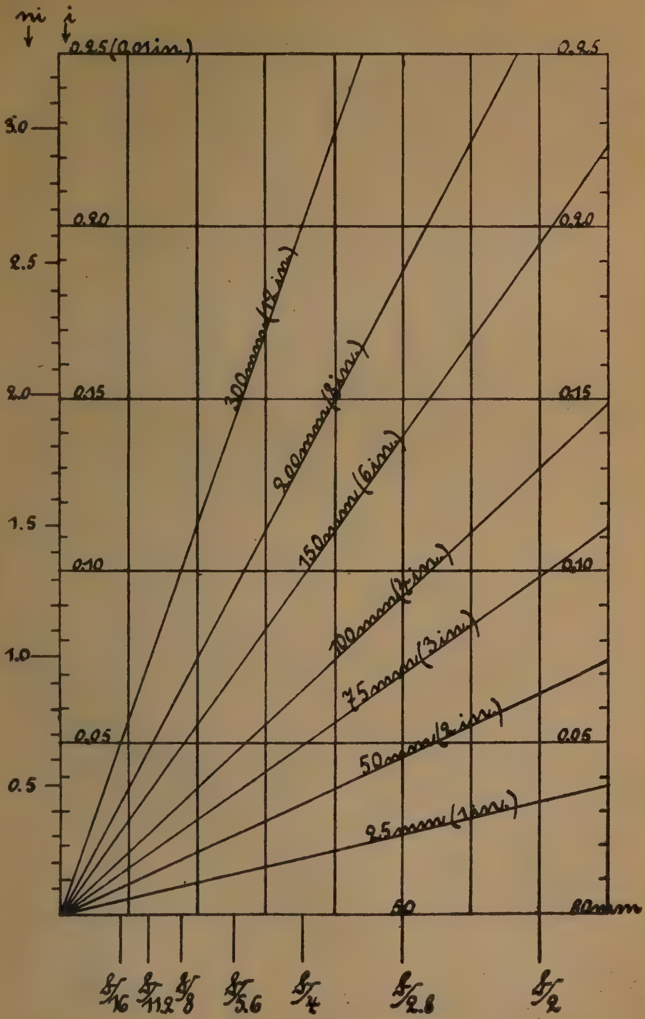

FIG. 10
Lines of equal depth of definition for an objective of f=140 mm. (5½ in.), focusse for a plane at a distance of 2 m. (6 feet 6·7 in.).

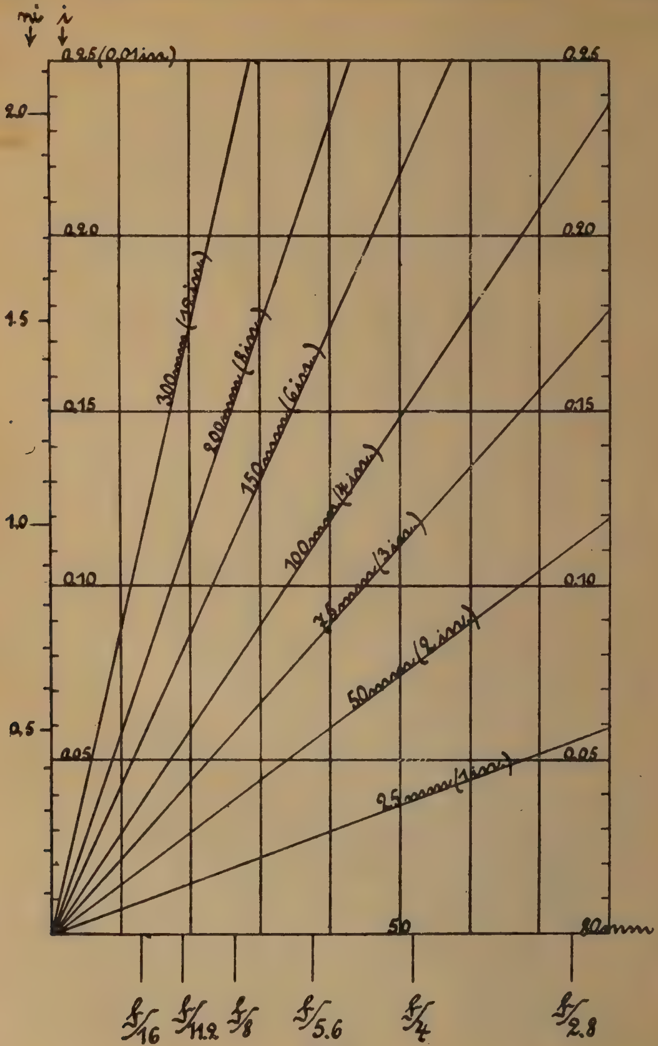

Fig. 11.

Lines of equal depth of definition for an objective of $f=210$ mm. (8¼ in.), focussed for a plane at a distance of 2 m. (6 feet 6·7 in.).

at the picture from the real centre of perspective. With regard to depth of definition—the distance from the pl. f.f. remaining unaltered—small lenses possess decided advantages even though we claim constant angular indistinctness. If the same depth of definition is our object, the time of exposure shortens as the square of the focal length, and, if the relative aperture of the lens remains unaltered, the depth of definition extends at least in the same ratio as the focal length decreases.

Dr. M. von Rohr.

PRACTICAL TRICOLOUR PHOTOGRAPHY.

(A paper read before the Royal Photographic Society.)

By Howard Farmer and Guy Symmons.

The details in this paper have exclusive reference to the special application of tricolour photography, in which typographic screen blocks are used as the method of printing. They have also exclusive reference to what is termed the direct method, that is to say, screen negatives having correct colour values are taken direct from the original, either with daylight or artificial light; the two great difficulties which have hitherto barred the adoption of this direct method have been the long exposure necessary—and the spreading, through halation in the film, of the screen dots. In the method herein described, the first, I believe, published in which full working details are given, both these difficulties are overcome, the former by the use of colour filters of very perfect transparency, and the latter by the use of desiccated plates.

The process is based on the teaching of Professor Clerk Maxwell and Louis Ducos du Hauron, the colour filters being substantially identical as regards the rays they transmit with those used by Professor Maxwell; the actual solutions used by him are not employed because in two cases they are unstable, and in the third case (copper chloride), the slightest alteration in the strength of the solution materially alters the absorption. The transparency of the three solutions is also not sufficiently perfect.

COLOUR FILTERS.

Liquid filters are employed and, colour qualities being equal, choice is given to inorganic salts in preference to dyes as being more constant in composition and colour absorption, more convenient in use and more readily obtainable. All the dyes and salts employed are obtained from Hopkin and Williams.

Stock Solutions.

Potassium chromate (yellow)	1200 grains.
Water sufficient to make total bulk	10 ounces.
Potassium bichromate (red)	300 grains.
Water sufficient to make total bulk	10 ounces.
Eosine (blue shade)	120 grains.
Water	10 ounces.
Methylene blue	5 grains.
Water	10 ounces.

All these solutions are filtered several times or allowed to stand several days and the clear portions decanted.

Filters for Yellow Printing Negative (Carefully Filtered).

Eosine (blue shade) stock solution	180 minims.
Water	20 ounces.

Used in quarter-inch section.

With this filter the whole of the ultra-violet rays passed by the lens and to which plates are sensitive, are allowed to act, and at the same time the eosine subdues the blue-green (spectrum); the result is to strongly differentiate the yellow printing negative from the others.

Up to the present we have found with most subjects that the advantages of this extra differentiation more than counterbalance the disadvantages: should it be preferred to work without the ultra-violet rays, the following formula is employed:—

Eosine (blue shade) stock solution	20 minims.
Potassium chromate (yellow) stock sol.	100 minims.
Water	20 ounces,

Used in quarter-inch section.

Should it further be desired to increase the effect of the blue-greens the eosine is omitted or reduced in quantity.

It will be observed that by increasing or diminishing the quantity of eosine and yellow chromate respectively, the spectrum action can be shifted laterally in either direction and either concentrated in one band or spread over a considerable area.

Filters for Crimson Printing Negative (Carefully Filtered or Decanted).

Potassium chromate stock solution	300 minims.
Methylene blue stock solution	110 minims.
Water	20 ounces.

Used in quarter-inch section.

With this filter the aim is to obtain the maximum effect in the greens combined with an equal action in the yellow-greens and blue-greens, this being necessary owing to the general lack of green luminosity in natural objects and pigments.

If desired more or less blue-green can be allowed to pass by weakening the yellow chromate or vice versâ.

If more or less of the yellow end of the spectrum is desired the methylene blue is weakened or vice versâ.

Filters for Blue Printing Negative (Carefully Filtered).

Potassium bichromate, stock solution	20 ounces.
Eosine (blue shade) stock solution	250 minims.
Ammonia .880	250 minims.

Used in quarter-inch section.

The ammonia is to redissolve the precipitate formed by the eosine when added to the bichromate solution.

With this filter the whole of the red end of the spectrum rays is allowed to act so far as the rays affect the Series B Lumière plate, the aim being to obtain the maximum effect in the red. The other limit in this filter is practically identical with the D sodium line, the action ending abruptly at this point; should it be preferred to carry the action further towards the green, the eosine can be reduced in quantity or omitted altogether.

When taking the negatives the following is the order and method of procedure :—

EXAMPLE.

The copy is fixed on the copying board, taking the usual care to ensure perfect flatness, and the prism being accurately levelled the image is roughly focussed on the screen the size required. The image is then centred by shifting the lateral or vertical portions of the copying board. The electric lamps are adjusted as near as possible to the copy as will ensure an equal illumination of all parts, and at the same time give freedom from surface reflections in the direction of the prism.

A glass cell which has been cleaned with a dilute (1—60) solution of hydrochloric acid, then thoroughly washed with water, is filled with the colour solution for the yellow printing negative, and the outer sides of the cell being perfectly cleaned and polished, it is placed in its position behind the lens, and the image accurately focussed with the aid of an eye-piece (focussing lens).

The Levy screen, which may be of any ruling with its lines at angles of 15 and 75 respectively from the base, that is the bottom edge of the camera, is placed in position and adjusted so that it will be at a suitable distance from the surface of the sensitive film. The actual distance varies with the size of the stop and the scale of gradation of the original, bearing in mind the necessity for keeping the exposure as short as possible; it is convenient in practice to employ a short screen distance in conjunction with a relatively large stop; we find a distance of $\frac{8}{64}$ of an inch between the ruled surface and the sensitive surface, combined with a 133 line ruling and a working aperture in the lens of *f*-45, a suitable adjustment for a large percentage of copies. It is obvious that special methods of measuring the *f* ratio will be required where different-shaped stops are used. It is to be understood that in this example a square-shaped stop is being used with its four sides diagonally across the rulings of the screen and the measurement for *f* ratio taken as the length of one side. For the yellow printing negative Mawson lantern plates are employed.

The plate is first taken and placed on an electric heater at a temperature of about 220°F. for two minutes, sliding it about to ensure all parts being equally heated; it is then placed against an upright support and painted on the back with :—

Avery's backing	1 part.
Water	1 part.

It dries immediately and is placed in the slide for exposure. After exposure the backing is removed by wiping with a wet sponge, taking care not to get any on the film side; the plate is then ready for development.

The formula published with Mawson lantern plates, but more concentrated, is employed for all three negatives.

STOCK SOLUTIONS.

No. 1.

Hydroquinone	240 grains.
Potassium bromide	240 grains.
Sodium metabisulphite	240 grains.
Water	30 ounces.

No. 2.

Potash (caustic)	480 grains.
Water	30 ounces.

For development equal parts of each solution are taken.

It should be noted that the concentration of the developer is adjusted so that it will be as strong as possible consistent with getting clean images. The development is carried as far as practicable without veiling, the usual test being to watch the shadows on the plate; the development being carried on until these parts show a tendency to veil, when the action is immediately stopped. After development the plates are rinsed and placed direct in the fixing bath.

FIXING.

Sodium thiosulphate (hypo)	4 ounces.
Water	20 ounces.
Sodium bisulphite	4 ounces.
Water	20 ounces.

For fixing we take:—

Hypo solution	20 ounces.
Bisulphite solution	2 ounces.

When fixed the plates are laid in a large porcelain dish slightly tilted at one end through which a stream of water is flowing; after five minutes' washing they are placed for ten minutes in:—

Alum	1 ounce.
Water	20 ounces.

After the alum bath they are washed ten minutes in the manner as described after fixing.

Beyond the question of getting a clean negative with freedom from ordinary defects, the negative is judged as to whether its dots will give colour values corresponding with the original or a modification of the same which may be required; for example, the subject may very likely be one which has a strong yellow tint all over, in which case there will be no violet and very little blue, and if this same quality is required in the reproduction this negative will practically be the same all over. On the other hand, another subject may have yellow high lights without whites, and yet another subject pure blue and violet colours, the latter being very essential; in this case the negative for the yellow printer will practically be a positive in so far as the luminosity of the copy is concerned.

Where it is required to obtain the full scale of yellow colour in the print, the dots in the shadows should be slightly larger than required in the finished negative to allow for the subsequent reducing. The dots in the high lights, on the other hand, should be more than touching one another, also to allow for the subsequent reducing and the powerful lead in intensification.

The negative being considered satisfactory is left in the washing bath while the crimson printing negative is being proceeded with, and for this a Lumière Series A is used.

The colour cell which has been used for the yellow printing negative is taken from the camera, the solution returned to the stock bottle, and the cell thoroughly rinsed with tepid water and drained for two minutes by placing it upside down on pure bibulous paper. It is then filled with the colour filter for the crimson printing negative, carefully wiped on its outer sides and reinserted in the camera without refocussing.

The same ruled screen is used as for the yellow printing negative, but turned so that its other side is now next the film, and the ruling at angles of 75 and 15 respectively from the base, the distance of the ruling from the film being kept the same. The position of the stop is also altered to suit the altered position of the rulings, i.e., so that its sides diagonally cross the screen rulings.

The Series A Lumière, which is employed for this negative, is desiccated and backed in precisely the same manner as the previous plate, a deepened light or other suitable means being employed to avoid fogging from light action.

The chief point to be considered in this negative is to carry the exposure of the green portions of the subject as far as possible without blocking up the dots representing the high lights; every assistance, such as screen distance, shape and size of stop which can aid this result being utilised, the reason for this special attention being largely due to the lack of green luminosity in the Prussian blue pigment almost universally employed for printing.

The second negative being finished and satisfactory the cell[1] is rinsed, washed, drained, and with its fresh solution for the blue printing again placed in the camera, precautions being taken all through these several occupations to avoid any movement of the camera, lens, prism, copying board, etc.

For this negative a separate ruled screen is employed with its rulings at 45 degrees to the base, so that it does not matter which side faces the sensitive plate. The position of the stop is altered so that its sides are correctly placed as compared with the screen, and for this negative the screen distance and ratio of stop remain the same as in the other two negatives.

The Series B Lumière plate employed is treated as in the other cases, suitable precautions being taken against light when in the dark room.

In this negative also the plate is exposed so that the reds can act fully on the plate; in fact they should generally be as near high light as possible.

The three negatives being judged satisfactory, the final operations of reducing, etc., are carried through.

Reducing.

The iodine and cyanide formula is employed.

Stock Solutions.

Potassium iodide	240 grains.
Iodine	120 grains.
Potassium cyanide	480 grains.
Water	10 ounces.

For use (mixed immediately before required) take:—

Cyanide solution	240 minims.
Iodine	40 minims.
Water	4 ounces.

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[1] Instead of using the same cell for all three-colour filters, separate cells which have been optically ground to plane surfaces or which have been selected and carefully tested, can be used.

The plates are placed in a white porcelain dish, the mixture poured over and the image reduced until on examination the smallest shadow dots begin to disappear. In practice in order to reach this point without failure from local action, etc., the plates are taken out of the solution, rinsed under the tap, and examined with a magnifying glass at successive stages of the reduction; when the plates are re-immersed in the reducer, the reducing action reduces much more rapidly. When sufficiently reduced the plates are washed for ten minutes or longer as before described; they are then ready for intensification.

INTENSIFICATION.

The lead intensifier, commonly used with wet plates, has been very successfully adapted for use with dry plates by Mr. Symmons, and is now employed for strengthening the opacities of the dots in all the negatives.

STOCK SOLUTIONS.

Nitric acid (commercial)	1 ounce.
Water	60 ounces.
Lead nitrate	480 grains.
Water	20 ounces.
Potassium ferricyanide	480 grains.
Water	20 ounces.
Ammonium hydro-sulphide	1 ounce.
Water	3 ounces.

The negatives are first placed in the nitric acid solution for one minute (a little longer or shorter period is not important except so far as it may induce frilling), washed five minutes and then placed in:—

Lead nitrate solution	2 ounces.
Ferricyanide solution	2 ounces.

until the image is yellow in colour through to the back of the film; they are then washed until the yellow colour bleaches, that is, it becomes white. They are then given a second bath in the nitric acid solution, one minute, washed five minutes and blackened with the ammonium hydro-sulphide, washed two minutes, treated with a third bath of nitric acid and again washed ten minutes and finally allowed to dry.

BLOCK MAKING.

The blocks for tricolour printing are carried through in much the same way as ordinary monotone subjects, and as it is not intended that this paper should be a treatise on block-making, only the main lines of the process are given—a good plane surface of homogeneous hard metal, free from scratches, dents, and other mechanical defects being chosen.

The plates, which we shall suppose are of copper a quarter of an inch larger than sufficient to include the subject, are cleaned by placing them on a thick pad of rubber lying in a sink and scrubbing with double washed emery and a hard brush (sold in the trade under the designation of a copper-plate polishing brush) until they are free from grease, tarnish and stains; they are then scrubbed with the same brush with washed whiting to give the plates a smoother surface than that imparted by the emery. They are then rinsed under a stream of water and attached to the whirler, clean side uppermost, taking care that they are centrally adjusted, and after wiping with a clean cloth to remove traces of whiting and rinsing under the tap they are ready for the sensitising solution.

Sensitising Solution.

Any solution suitable for blocks can be used, the following formula being a useful one:—

No. 1.

Fish glue (clarified)	3 ounces.
Chromic acid (saturated solution)	5 minims.
Ammonium bichromate	120 grains.
Water	5 ounces.

No. 2.

White of fresh eggs	3 ounces.
Water	5 ounces.

No. 2 is beaten up and added to No. 1, and the mixture allowed to stand twelve hours. It will keep good in a cool place for three weeks or more. Immediately before it is required for coating the copper, it is filtered through a piece of washed cotton wool which has been placed in the neck of a funnel and moistened with water.

The sensitising solution is poured over the copper plate, held by the pneumatic holder so that its outer surface is horizontal, from one corner, and the plate tipped so that the fluid runs along one side, round the next side, and finally drains off the last corner; this operation is repeated a second time from the same corner as before, and a third quantity of the fluid is then poured on the centre of the plate and before it has time to spread to the edges the whirler is turned over, so that the plate is now undermost, and immediately over a heated plate (lying on a ring Bunsen burner) and at the same time is slowly whirled until the film is perfectly dry (about two minutes); this operation is conducted in a room lighted through yellow glass.

Precaution should be taken (1) not to make the coper plate too hot, as the film will slowly become insoluble, and (2) not to twirl too fast when commencing, as the film will then become too attenuated, and will leave the metal during the etching.

When dry the plate is taken from the whirler and placed in position in contact with the film of the negative in the printing-frame, care being taken that the negative and plate glass of the frame are perfectly free from grit or dirt, which would invariably break the negative when the strong pressure required is applied, and thus render the whole set useless. A thick felt pad is placed next the copper and the frame closed and the back screwed down to the required pressure. The frame is now placed in the light, either daylight or an electric lamp, and exposed until a slip of P.O.P. next the negative in the frame has darkened about half way to its darkest tone (about one minute in daylight or five minutes at about a distance of nine inches from a good arc lamp carrying 25 amperes). After exposure the copper plate is taken out of the frame and placed film uppermost in clean water for a short time (one minute); it is then rinsed under the tap and placed for three minutes in dilute ammonia 20 minims, water 20 ounces; it is again rinsed and stained by immersion in a solution of methylene blue (10 grains in 20 ounces of water) about three minutes. It is next washed in running water until the picture appears quite clean, that is, when the dye is thoroughly washed out from all portions except where retained by the insoluble portion of the film.

The appearance of the picture when examined by a magnifying glass will show whether the exposure has been correct. The plate is next dried off with methylated alcohol, and is then ready for burning in; for this purpose and in the case of a small plate it is held between pincers at one corner over a powerful Bunsen gas stove, moving the plate about and changing the pincers from corner to corner until the high lights of the plate turn red; then at once take away from the burner, allowing the heat contained in the copper plate itself to finish the burning in, which is signified by the high lights changing to a silver colour; the plate is then laid on a stone or metal slab to cool. On examination of the cooled plate it should be free from mechanical defects such as dots missing, holes, scratches, the effects of finger marks, etc. If any small defects are seen they are painted over with an acid-resist varnish such as bitumen or shellac varnish; the back and edges of the plate are also covered with the same varnish, and when dry the plate is ready for etching.

ETCHING.

Ferric chloride is dissolved in water to a strength of 40° Beaumé; to each twenty-eight pounds of iron, two pounds of ferric hydrate are then added and stirred occasionally during one or two days. then allowed to deposit, and the clear fluid decanted for use.

The solution is placed in a large porcelain basin and heated over a gas stove to 110° F. and is poured into a rocking bath, and when the temperature has cooled to 100° F. the plates are put into the bath film uppermost, the bath being kept in motion for about one minute; after this time the plates as they lie in the fluid are brushed once to and fro, north to south and east to west, with an etching brush (a flat camel's-hair brush bound with wood). The rocking is continued until the total line of etching is from five to eight minutes, the exact time depending upon the size of the dots; if the dots in the high lights are large, and assuming they are to represent white, the etching is continued longer; if on the other hand they are already, at an earlier stage of etching, so small that longer etching would remove them by under-biting, the action is stopped. When it is decided to discontinue the etching the plates are removed and washed under a full stream of water, and then dried by direct pressure (dabbing) with a cloth free from fluff.

The black or other resisting varnish with which the back, margins, etc., of the plates have been protected is now removed with suitable solvents and rough proofs in black ink are taken from the three blocks.

PROOFING IN BLACK.

This is for the purpose of ascertaining whether the etching of the plates has been carried far enough, that is to say, it is obviously impossible to know exactly during the etching whether the high lights have been carried just as far as is safe without spoiling the blocks, and whether also the other tones have reached their proper values. If it is found on proofing that either the high lights or other tones are too dark, the etching of the plates is carried further by protecting the portions already sufficiently light with resist, while the remaining parts are lightened, and this may be done either by immersing the plates in the bath, or by painting with a brush charged with the iron solution; if the plates are perfectly dry, the painting out with resist can be omitted, and the re-etching carried out by simply painting the parts it is required to lighten in the manner referred to. It is very important in the process of re-etching that the plates should be thoroughly cleansed both from the varnish resist, which has been used for protecting the portions of the plates from the etching fluid, and the ink which has been used for proofing, and if it is intended to re-etch without applying any resist, they should be thoroughly dry. This is accomplished either by slightly heating the plates over a gas-stove or by pouring on the plates a few drops of benzol, which not only loosens the adhesion of the water to the copper, etc., but also helps to remove any traces of ink, grease, etc., and finally wiped with a dry rag. The process of re-etching may be repeated several times until by the examination of the plates with a magnifying-glass and by proofing they are judged to be correct.

PROOFING IN COLOURS.

At this stage of the work it becomes necessary to print the plates in correct register, and while, in a printing establishment, the plates may be trimmed and mounted as blocks before the colour proofs are taken, and without any previous attention to register masks, we have found the method employed by lithographers for registering their colours a very convenient one for use in a small laboratory where the methods for registering as employed by printers are not available, and it is required to test the colour values of the prints before the plates are cut and mounted. The method we employ consists in ruling as near as possible to the margin of the original, and before it is photographed, cross marks in black ink on a white ground, at two ends, care being taken that each of these cross marks is reproduced in the margins of each copper plate. When they are printed in the fish-glue resist, these marks are not painted out with the etching resist, but are etched with the image, and will therefore print on the proof. Before the colour proofs are taken, small conical holes are punched exactly in the centre of the cross-lines of each plate. An Albion press made specially for half-tone proofing is employed, and the plates laid unmounted on a steel bed type high. The yellow proofs are first taken and hung up about eight hours, or until the ink has hardened sufficiently to allow the crimson printing to be taken on top, but before this is done small perforations are made with a needle through the centre of each of the register marks (cross-lines), and when the plate has been rolled up with the crimson ink the yellow print is lowered into its exact position for register with the aid of two long needles, which are fixed in handles, and which are passed through the holes from the back of the yellow prints, and are held with their points in the holes of the plates, and with their length upright until the point reaches the surface of the copper. When the crimson ink has also hardened sufficiently, the blue printing is carried out in exactly the same manner.

The coloured proof is now compared with the original, and if this discloses the necessity for further re-etching, it is carried out.

The blocks are now ready for trimming and mounting, and a practical difficulty arises in trimming so that the margins of all three blocks will coincide. There are several methods in use to ensure accuracy in this respect. The following has been devised by Mr. Symmons, and is the one employed.

A proof is first taken in black ink on card from any one of the plates, and the amount and shape of the subject required is then cut out from this card; the register marks are then punched, and the card replaced with the aid of the needles in register with the image on the copper, taking care when the card is turned over that there are marks to indicate one end from the other. Marks are now made on the copper corresponding with the opening in the card, and if this description of the mode of working has been followed, it is obvious that exactly similar marks can be made on the other two coppers by carrying out the same directions, and in printing the margins of all three prints will be identical.

THE OPTICS OF TRICOLOUR PHOTOGRAPHY.

By Howard Farmer.

[A paper read before the Royal Photographic Society and reprinted from its "Journal."]

Believing that the true principles of tricolour photography are those given to us by Professor Clerk Maxwell, and not those so persistently advocated by Mr. Ives, the following paper contains mainly evidence on which this belief is founded.

Under the date January, 1860, with the title "The Theory of Compound Colours," the "Transactions of the Royal Society" contain Professor Clerk Maxwell's quantitative evidence of the formation of all colours, from the admixture, in different proportions, of three spectrum colours.

In awarding to Professor Maxwell the Rumford Medal for this paper, Major-General Sabine, the then Vice-President of the Royal Society, said,[1] "The researches for which the Rumford Medal is awarded lead to the remarkable result that, to a very near degree of approximation, all the colours of the spectrum, and therefore all colours in nature, which are only mixtures of these, can be perfectly imitated by mixtures of three actually attainable colours, which are the red, blue and green, belonging respectively to three particular parts of the spectrum."

The following year, May 17, 1861, Professor Maxwell lectured at the Royal Institution on the same subject, and demonstrated as an application of his researches, a system of colour photography in which photographic images, taken through three coloured solutions of sulphocyanide of iron, chloride of copper, and ammoniated copper respectively, were subsequently superimposed, by projecting them with three magic lanterns, through the same coloured solutions.

It is much to the point to notice that in indicating to us the application to photography of the knowledge gained in his researches, Professor Maxwell entirely departed from the method he, and he alone, had given us, for the formation of all colours by the admixture of three spectrum colours, as shown diagrammatically in his curves, and so clearly referred to by Major-General Sabine.

Some years afterwards (1869) Monsieur Louis Ducos du Hauron, being then unaware of Professor Maxwell's previous work, invented the Photochromoscope, the Tricolour print system of synthesis and other applications of tricolour photography, and in his book, "Les Couleurs en Photographie," published his mode of working. This was the same as Professor Maxwell's, that is to say, he employed for his positive analysis the same filters red, green, and blue, that he used for his chromatic synthesis.

Mons. Chas. Cros and later others, including Professor Vogel and Baron Hubl, also gave similar methods.

In 1888, Mr. Frederic E. Ives, of Philadelphia, published in the "Journal of the Franklin Institute," and subsequently in pamphlet form with the title, "A New Principle of Heliochromy," a different system of working. This system consists briefly, in the application of Professor Maxwell's spectrum work to photography; that is, a photographic analysis in strict accord with Maxwell's spectrum curves, and a photographic synthesis in equally strict accord with Maxwell's spectrum primaries.

During many years past, Mr. Ives, backed up by his Kromskop results, the undoubted excellence of which, we have been led to believe, is due to the adoption of his so-called new principle, but relying entirely on Professor Maxwell's spectrum work for his scientific support, and without, so far as I am aware, a single definite experiment, to confirm or otherwise the accuracy of his views, has actively proclaimed himself the originator of the only correct optical system of practical tricolour photography, and discredited and condemned as rubbish the system employed by Professor Maxwell, Ducos du Hauron, Vogel, and others.

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[1] "James Clerk Maxwell and Modern Physics." By Professor A. T. Glazebrook, F.R.S. (Cassell & Co.)

Mr. Ives' recent Traill Taylor Memorial Lecture delivered in these rooms, is a fair sample of his treatment of the subject; he has also lectured, unquestioned, to the same effect, at nearly all our leading scientific institutions, and the "Ives' principle" has now, I believe, been copied into every text-book on the subject in the English language, as the correct guide to practice.

We may well pause and ask ourselves, why one of the most accurate investigators and thinkers of modern times, Professor Maxwell, seeing, as he undoubtedly did, the co-relationship between these colour schemes as clearly as we see the relationship between the different parts of a four-legged table did not himself indicate to us the use of his spectrum curves, in conjunction with his spectrum primaries, for photography. but on the other hand, used the same group of rays both for analysis and synthesis; also, why the inventive genius, Louis Ducos du Hauron, to say nothing of others, followed in the same steps as Maxwell.

Before attempting to give a satisfactory answer to this question, it will be advantageous to examine the practical working of the two systems.

It has already been shown[1] by Baron Hubl, that the methods of Du Hauron, Du Cros, Vogel, etc., are in practice substantially the same, and I have shown[2] that these gentlemen's methods are in their turn also substantially identical with Professor Maxwell's; we can therefore pass on to Mr. Ives' practice and compare it with Maxwell's.

It will be convenient to divide the examination into two sections:—

First, the two systems of analysis.

Second, the two systems of synthesis.

Taking, in the first place, the two systems of analysis, the one Maxwell's, with three solutions of ferric sulphocyanide, copper chloride, and ammoniated copper respectively, and the other Ives', with Maxwell's curves. Sets of Maxwell's three solutions were prepared, and adjusted as to correct strength with the aid of a Maxwell's colour box, that is to say, they were rendered identical in colour and visual purity with his three spectrum primaries—the essential condition laid down by him in his lecture at the Royal Institution referred to. The quantities resulting were as follows:—

No. 1.

Cupric sulphate (pure cryst.)	120 grains.
Ammonia .880	120 minims.
Water (distilled)	4 ounces.

Used in a cell of quarter-inch section.

No. 2.

Cupric chloride (pure cryst.)	5760 grains.
Water (distilled)	20 ounces.

Used in a cell of one-inch section.

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[1] The British Journal of Photography, March 18, 1898.

[2] *Ibid.*, March 8, 1901.

No. 3.

Ferric sulphocyanide (pure cryst.) ... stock solution, 240 grains.
Water (distilled) .... ,, 20 ounces.

The last named diluted when required as follows:—

Stock solution (No. 3) .... 360 minims.
Water (distilled) .... 4 ounces.

and used in a cell of quarter-inch section.

Four sets of Ives' filters were employed for comparison with Maxwell's, supplied under Mr. Ives' instructions, to four different firms or persons, and at widely different times.

The following tests were made:—

I.—Visual test.
II.—Spectroscopic tests.
III.—Camera tests.

I.—Visual Test.

For the purpose of this test, the colours of the commingled rays contained (with approximately proper intensities) in each of Maxwell's curves, were ascertained with the colour box, and found to be orange, greenish-yellow, and blue respectively.

The colours of Mr. Ives' filters were not found to compare with this orange, greenish-yellow, and blue, the colours they should conform to in accordance with his teaching; they were, however, found to be the same in colour as Professor Maxwell's three solutions, not so pure, but otherwise the same.

II.—Spectroscopic Tests.

Again, the Ives' filters showed no evidence of Maxwell's curves, or any similar curves, with the exception of the green filter, whose action falls off towards the blue in a somewhat similar manner to Maxwell's curve; on the contrary, they give three practically isolated bands, identical with those given by Maxwell's three solutions.

It should be remarked also that the falling off of transparency towards the blue, in the case of the green filter, may be required, quite independently of the Ives' principle. This would be the case when using ordinary plates, or imperfectly sensitive orthochromatic plates, for tri-colour work, and when owing to the rapidly increasing sensitiveness of the plates, from a point usually commencing in the middle green, towards the blue, it becomes essential to reduce the quantity of blue-green rays acting to compensate for the greater sensitiveness of the plates to these rays.

The theoretical defects introduced by the weakened action of the blue-green when using plates as per Mr. Ives' instructions would be the conversion of blue-greens into blues and violet-blues in the case of positive synthesis, and into blacks in the case of colour prints. A direct and careful experimental test, with a colour chart containing various shades of these colours, with the Ives filters, as against the Maxwell filters, showed that these are defects characteristic of the former.

Similar remarks and confirmatory evidence may be made and given in reference to Mr. Sanger Shepherd's filters. Mr. Sanger Shepherd, I believe, supports the teaching of Mr. Ives, but his analysis filters are adjusted by means of a special form of sensitometer, and apparently without reference to the Maxwell's curves. Two sets of these have been tested, and there is no evidence in their spectrum records in support of Mr. Ives, or to suggest the Maxwell or similar curves; on the contrary, they give practically identical records as those given by Professor Maxwell's three solutions, and undoubtedly owe the excellence of the results they give to this identity; therefore it may be said that, in his practical work, Mr. Sanger Shepherd is accumulating evidence of the correctness of Professor Maxwell's teaching.

Again, with the American Carbutt filters similar results were obtained, and whatever degree of accuracy they give is due to their rough approximation to Professor Maxwell's three solutions.

In all these tests the plates used were those to which, according to the instructions issued with the filters, the filters had been adjusted.

III.—Camera Tests.

The photographed spectrum tests, being in themselves conclusive, and the comparisons of the results in practical tricolour work, when using the Ives principle, as against the Maxwell system, having already been published in an article contributed to The British Journal of Photography, February 1, 1901, and the defects arising from the employment of the former fully pointed out, they are not included here. They, however, fully confirm the accuracy of Professor Maxwell's system.

THE TWO SYSTEMS OF SYNTHESIS.

Taking in the second case for consideration the two systems of synthesis, the one Maxwell's and the other Ives', it will be found on reading through Mr. Ives' definition of the principles of successful tricolour photography in his recent Traill Taylor lecture, that his condition of success, as regards synthesis, is the use of Maxwell's simple spectrum primaries. This same condition is also claimed for Mr. Ives as one of his specifications in the report of the scientific experts to the Franklin Institute, whom he has so frequently referred to in support of his claims; but directly the practical standpoint is reached Mr. Ives drops this condition of success and his own specification.

The synthetical primaries employed in the Kromskop and in the Ives triple lantern were found greatly inferior in purity, but substantially the same in their useful ray composition as the Maxwell three-solution primaries. The only explanation I can find of this departure of Mr. Ives from his own teaching is contained in the handbook to the Photochromoscope, page 15, and is to the following effect:—

"Photochromoscopes were first made with screens of very pure colour in order to realise every theoretical requirement, but people imagined the productions to be more strongly coloured than the originals. Owing to the prevalence of this error of judgment, it has been found permissible to compromise by a slight reduction in purity."

It may be remarked that this slight reduction amounts to the substitution in the case of the green, for example, of two-thirds of the entire spectrum for a single narrow band.

To sum up these various tests we may recognise that it is hardly possible to conceive anything more directly opposed to the tenets of his teaching than Mr. Ives' own practice as exemplified by his analysis filters and synthetical glasses, and without attempting to criticise these departures from his own first principles, enough has been said, whatever the reasons may be, to indicate that in doing so he has adopted the system of Professor Maxwell.

It will now be convenient to point out the true relation which our photographic processes bear to Professor Maxwell's spectrum work and the Ives principle. In the synthesis of colours in which Maxwell's curves formed the basis, three narrow bands of practically homogeneous rays were used as primaries, but this homogeneity of ray composition is not essential to retain the colour of the primaries; on the contrary, the spectral rays comprising them can form broadened portions of the spectrum, providing the rays added from one side of the homogeneous primary are balanced with a suitable quantity from the other side; and, as readily shown with Professor Maxwell's colour box, his three homogeneous primaries can be matched, without sensible loss of visual purity, by three commingled bands of spectrum rays, comprising together nearly the entire spectrum. Further, these broadened or compound primaries, having this maximum luminosity, are substantially identical, in their ray composition, with the rays transmitted by Maxwell's three solutions, as also with the rays reflected by pigmentary primaries of maximum luminosity.

Directly these broadened primaries are applied to the reproduction of compound, that is natural colours, the Maxwell spectrum curves no longer represent the proper proportions for the formation of other colours, but for every degree in which the primaries are broadened, a different set of spectrum records are required, the suitable records, as the primaries are widened, becoming shorter and overlapping less. This goes on until the primaries contain the maximum number of useful rays, and are similar in composition to the rays transmitted by Maxwell's three solutions. Under these circumstances the spectrum records representing the most perfect reproductions both in hue and luminosity values have no longer any overlapping portions, and their limits of action correspond also with the rays passed by the three solutions. This may be summed up by saying that Professor Maxwell's three solutions, in the practical sense, occupy the same position and fulfil the same functions for the reproduction of natural colours, by means of primaries of maximum luminosity, as his curves do, in relation to his simple spectrum primaries.

There are two broad applications of the tricolour principle in photography, the one positive synthesis, as exemplified in triple lantern projection, and the other invented by Louis Ducos du Hauron, negative synthesis, in which colour prints are obtained by printing with the complementary colours to the primaries. Of these two broad applications, the latter will generally be regarded as vastly the more important, provided always that the colour prints can be viewed in ordinary white light. This essential condition excludes the use of narrow spectrum bands, and necessitates the employment of compound colours, which are complementary to primaries having the maximum luminosities, in other words, complementary to the rays passed by Maxwell's three solutions. Also in positive synthesis, where it is conceivable narrow bands of colour approaching Maxwell's spectrum primaries might be used, we have the recognition by all workers, including Mr. Ives in his practice, of the advantages derived from the use of primaries of maximum luminosity.

This condition then being recognised, the problem at once resolved itself into the production, in the photographic analysis, of records which represent the proper proportions of primaries having maximum luminosities, required for positive synthesis; and this consists, as indicated to us by Profesor Maxwell, in the employment of the same rays for analysis as for synthesis.

We can now offer an explanation as to why Professor Maxwell did not himself suggest to us the application of his spectrum curves to photography. The truth is, that as a matter of fact, they do not touch the subject, as they cannot usefully be dealt with in practice—they have exclusive reference to the use, for synthesis, of three narrow bands of spectrum rays, for the purpose of a scientific verification of the theory of compound colours, and have no known application in practical tri-colour photography.

On the other hand, if starting in ignorance to ascertain the most correct method of practical photographic analysis, we take different paths; each choosing the one, according to our idiosyncrasy, the most likely to lead to the best system; whether like Du Hauron we let our theory go hand in hand with our practice, or whether we follow Dr. Vogel's principle, or Baron Hubl's colour scheme, or whether we adopt the trial and error system, of the practical operator; or like Mr. Ives, endeavour to make a system of our own—by the time we arrive at the best results, all the evidence at our disposal at the present time points to the method being substantially identical with that originally indicated, in 1861, by our great countryman, Professor James Clerk Maxwell.

THE OPTICS OF TRICHROMATIC PHOTOGRAPHY.

[The Third Traill Taylor Memorial Lecture.]

By F. E. Ives.

The trichromatic process of colour photography consists essentially in (1) the production of three photographic images which represent the physiological analysis of all colours into three simple spectrum colours, and constitute a colour record, and (2) synthesis by optical superposition of the three elements of the colour record in the three simple colours, whereby the sensations of all the original colours are reproduced to the eye.

Such analysis and synthesis is possible because there are three spectrum colours, which by admixture in suitable proportions will reproduce to the eye the sensation of every other spectrum colour. These three simple colours are the red of the spectrum, about the Fraunhofer line c, the green near b, and the blue near g.

What particular colours must be employed, and the proportions in which they must be mixed to reproduce to the eye the sensation of the intermediate spectrum hues, was first determined by Professor James Clerk Maxwell, and is shown by his famous "colour curves," which I reproduce.

These factors have been redetermined by Sir William Abney, with an improvement upon Maxwell's colour box, but Maxwell's results are shown to be substantially correct, and I therefore prefer to use Maxwell's diagram in illustration, because of its historical bearing upon the subject.

Maxwell's curves are colour-mixture curves, and not to be confounded with colour-sensation curves, which assume a fundamental green sensation which no part of the spectrum excites exclusively. In trichromatic photography we have to deal with mixtures of actual spectrum colours.

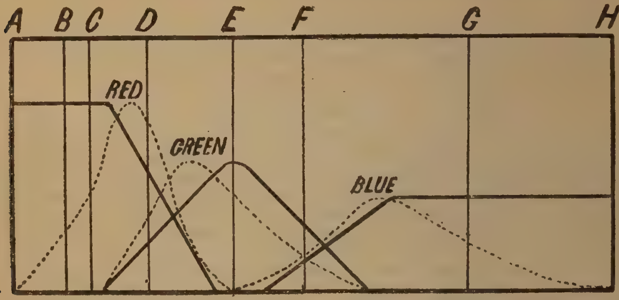
The relative height of the respective curves at any point indicates the proportions of the simple colours required to produce to the eye the colour of the spectrum at that point.

It follows that in order to obtain a trichromatic colour record of the spectrum itself, three photographs of the spectrum must be made, in each of which the distribution of photographic action is such as would be represented graphically by the respective curve in Maxwell's diagram.

The picture to represent the red element in the analysis must be made not only by the action of the red rays, but by the action of orange-yellow and yellow-green rays, in proportion to the relative amount of red light required to represent the latter colours in the synthesis, by admixture of green; and, as shown by the "red" curve in Maxwell's diagram, the strongest action of all, instead of being in the red, will be in the orange, which is reproduced to the eye in its correct relative luminosity by mixing the greatest amount of red with a little green.

Similarly, the negative to represent the green element must be made by the joint action of orange, yellow, yellow-green, green and green-blue light, with the strongest action in the yellow-green, as shown by the second curve; and the third negative by the joint action of green-blue, blue and spectrum violet light, as shown by the third curve.

If the distribution of photographic action does not correspond to the form of these curves, the analysis will be imperfect, and correct synthesis becomes impossible. If the yellow of the spectrum does not act in both the red and green negatives, it must be reproduced either as red or as green; and if it acts in both negatives, but not in the correct relative proportions, it will be reproduced either as orange or as yellow-green. To ensure accurate results, the photographic analysis must be a quantitative analysis, and a correct quantitative analysis, and no other, will admit of the synthetical reproduction of the spectrum itself, with all its gradations of colour and luminosity.



All the colours in nature are mixtures of spectrum colours; therefore it may be taken as an axiom, that the ability or inability to reproduce the spectrum itself credits or discredits any trichromatic process.

If you can obtain by photography such a colour record of the spectrum as I have described, you can by the same means obtain true colour records in photographs from nature and works of art; but, if the spectrum test in any way fails, no real accuracy can be guaranteed or should be expected.

To secure negatives of the required character, we must employ colour-sensitive photographic plates, and filter the spectrum rays through suitable coloured mediums, testing by exposures in the photo-spectrograph and modifying the colour filters until the density curves conform to Maxwell's colour curves. Such adjusted colour filters I term "colour-curve screens." This system of photographic analysis I call "colour-curve analysis," and the photographic records "colour-curve records."

Although there are various methods of synthesis, positive (photo-chromoscopic) and negative (colour prints), the photographic record that is correct for one is correct for the other.

An incorrect colour record cannot be made to yield a correct synthesis by any means whatever.

Positive synthesis may be obtained by making a positive colour record (a transparency) from the negative colour record, and projecting the three images separately in three magic lanterns, each with light of the simple colour which it represents, and all superposed in register to form a single sharp composite image upon the screen.

Lest a most important point be missed, I repeat that the synthesis must be obtained with the simple colours, red, green, and blue, although the records have been made by the action of mixtures of various spectrum colours. Thus, although the record for red is made in the joint action of red, orange, yellow, and yellow-green light, this image must be pure red in the synthesis. Correct synthesis, therefore, demands the use of "pure colour" screens, in contradistinction to the "colour curve" screens pertaining to the process of analysis.

If we were to use the same screens for both analysis and synthesis, the results, in dealing with the spectrum, could not possibly be correct. The reason for this should be evident to any one who has followed my argument, but in a few words I will give one or two illustrations.

Suppose we make our colour records of the spectrum through "pure colour" screens; then only the two ends of the spectrum and a band in the middle will be reproduced, the remaining portions appearing as broad, dark spaces in the synthesis, because such screens transmit none of the intermediate spectrum rays. Suppose, on the other hand, that we attempt the synthesis with the "colour-curve" screens; the simple colours red, green, and blue, cannot be reproduced, because the respective screens transmit other spectrum colours along with these.

In short, it is absolutely necessary, in order to obtain a true colour record, to photograph through "colour-curve" screens, and correct synthesis is possible only with "pure colour screens."

It is true it may happen that, in dealing with compound colours, the effects of departure from theoretically correct conditions will not always result so disastrously as in dealing with the spectrum itself; but no reliance can be placed upon any but fundamentally correct methods.

It is also true that the habit of the eye and mind, due to familiarity with monochromatic photographic reproductions, makes some dilution of colour acceptable to most people, but a recognition of the principle I have stated is necessary in order to introduce this dilution without change of hue. The dilution must be equivalent to admixture of white light only, and this is most perfectly effected by broadening the spectrum bands which are taken as synthesis colours without materially displacing them.

In positive synthesis we build up our composite colour photographic image by adding light to light, red, green, and blue, as already described; but we may also employ a method of negative synthesis, producing fixed colour prints upon paper or glass, in which case we commence with our white surface, and build up the picture by superposing coloured shadows (transparent colour prints) upon it.

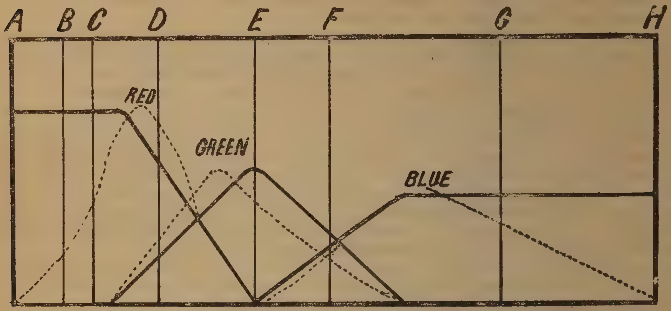
This method is essentially complementary to the other, and the colours of the transparent prints are like the shadows of the corresponding positions in the white field of the triple lantern.

Red, green, and blue, being the colours in positive synthesis, minus red, minus green, and minus blue, or cyan blue, bright crimson, and yellow, are the printing colours.

If our white surface, against which these colour prints are superposed, were a white made by mixing red, green, and blue spectrum rays, no further definition of the printing colours would be necessary. Inasmuch, however, as our white is ordinarily made up of all the spectrum rays, it becomes necessary to consider the absorption of the colours in the intermediate spectrum regions.

The function of the printing colours is to most efficiently subtract from ordinary white light the visual impression belonging to the respective simple colour elements. In other words, the printing colours as seen in ordinary white light should appear to match as nearly as possible the minus (shadow) colours which may be produced in the physiologically white field of a device for positive synthesis.

This would not be accomplished by absorptions complementary to the correct photographic action, for the reason, for instance, that a minus red (C line) is considerably more antichromatic to the red element than a minus yellow (D line), although the yellow is more active than the red in the production of the respective negative, in accordance with Maxwell's curves.



I will give one practical illustration. The absorption of the dye cyanine is in approximate concordance with the Maxwell red curve, and, when it is used as a colour sensitiser on a suitable photographic plate, it yields a density curve also pretty close to the Maxwell red curve; but this colour, in ordinary daylight, is no more like our minus red than cobalt-blue glass is like signal green.

The relative efficiency of the absorption falls as we go towards the next "primary" in the spectrum, because it involves simultaneous damping of the visual impression of that other "primary."

It follows from this that the absorption of the printing colours should not conform to the Maxwell curves, but should be greatest for the "pure" colours, and fall gradually to the position of the next "primary" in the spectrum. Such absorptions are shown in the diagram given herewith, the Maxwell curves being shown by dotted lines, and the printing colour absorptions by the full lines.

These three absorptions, added together, make a neutral black or grey in ordinary white light, but absorptions according to the Maxwell curves would make a dark purple, because the pure red and violet spectrum rays would not be all absorbed. This drawing, although imperfect, sufficiently illustrates a principle which I have long recognised and tried to make clear to others.

I hope the illustrations which I have now given will make it sufficiently clear that in negative synthesis the printing colour absorptions should differ from the photographic analysis curves for the same reason that in positive synthesis it is necessary to employ "pure colour" screens instead of "colour curve" screens; but it is also evident that the distinction cannot be as complete, nor the result as perfect, because of the different character of the white light in the two cases.

As I have frequently pointed out, and as analysis of all the absorption diagrams will prove conclusively, synthesis by colour prints introduces a perceptible though not necessarily offensive dilution or degradation of colours, which, however, should disappear altogether if the prints are viewed in a mixture of pure red, green, and blue light.

In short, it is not possible, in ordinary white light, to reproduce all of the spectrum colours undiluted by means of any three printing colours, for the same reason that it cannot be done in positive synthesis by means of "colour curve" screens; but the best approximation may be obtained by using the printing colours most specifically antichromatic to the respective colour elements in ordinary white light.

Let me here emphasise the fact that the slight degradation of colour which the spectrum test will disclose even with such printing colours as I have indicated is in no material degree the fault of the photographic analysis, but is inherent in the printing colours. Analysis of the absorption curves of any three printing colours will demonstrate that by no means whatever can they be combined to reproduce the spectrum without some dilution or degradation, which may be either general and reduced to the lowest minimum, as with the colours I have indicated, or localised, so as to introduce changes of hue, which would be far more objectionable.

It is also necessary to point out that the comparatively short scale of correct gradation of the photographic process is always working against a tendency to weaken colour contrasts which might otherwise be expected, but also that, just in proportion as the colour contrasts are thus intensified, other, and I think more important, qualities are sacrificed. It is generally far better to sacrifice something of the purity of colours than to alter their hues.

Synthesis by the positive method offers the advantage not only of far greater simplicity, but of yielding every other quality along with practically undiminished purity of colour.

When I originally stated these propositions, they were dismissed by many as "mere assertions," "speculations, unsupported by argument or experimental proof," "pretentious and unfounded judgments," "theories, which have nothing to do with practice," etc.

It has always seemed to me that they were such logical deductions from the experimentally verified facts of spectrum colour analysis, that it would be an insult to intelligence to devote time and space to argument and illustration. I am of the same opinion still, but have, nevertheless, tried to fortify myself this time with some arguments and illustrations, which I think go as far as should be necessary for anybody who can comprehend a simple theory.

It was by adhering to the conditions which I have laid down that I succeeded, at a time when the capabilities of trichromatic photography were almost universally discredited, in reproducing test subjects to the entire satisfaction of a committee of scientists appointed to investigate the subject.

I shall now proceed to consider the genesis of the various methods which have been proposed, showing as well as I can what elements of success were contributed by each worker, and wherein each failed, until all the conditions of success were realised.

The first suggestion was made by Prof. James Clerk-Maxwell, in a lecture at the Royal Institution, May 17, 1861. This lecture was never published in full, but a report of it was printed in the "Journal" of the Royal Institution.[1] According to this report, he proposed the production of three photographs to represent the three fundamental colour sensations, by exposing photographic sensitive plates through colour filters, and synthesis by triple lantern projection through the same colour filters. I am inclined to believe that the principle of colour-curve analysis and pure colour synthesis was fully recognised by Clerk-Maxwell, and that it was only by an oversight that this distinction was not set forth in the brief report of his lecture. In short, I believe that his invention may have been theoretically complete for the recording of colours by photography, and their reproduction by triple lantern projection, but that it was lost to the world by insufficient publication.

The next published suggestion was made by Henry Collen, in a letter to The British Journal of Photography (p. 547, Oct. 27, 1865). Collen, who accepted Brewster's theory of three primary colours of light, red, yellow, and blue, proposed the production of a separate negative by the action of each primary colour, and negative synthesis by the production and superposition of transparent colour prints. He suggested that the negatives should be made on thin pellicles, and that they should be superposed two and two to print transparent images of the third colour; thus, the negative made by blue light and the negative made by yellow light should be superposed and used as one in making the red print, the red and blue negatives for making a yellow print, and the red and yellow negatives for making a blue print.

There were three defects in this proposition, any one of which would have been fatal. First, the wrong idea as to primary colours. Second, the fact that prints in true red, yellow, and true blue cannot be made to even approximately reproduce all colours. Third, that the combination of two negatives doubles the opacity of all whites and greys, without altering the opacity in the records of the pure colours.

The result of this would be that when the printing was carried far enough to show details in the whites (opaque in two negatives), the pure colours (each opaque in only one negative), instead of printing like the whites, as they should, would print half way down to the deepest shadows in density, and reduce the relative luminosity of colours by nearly 50 per cent. in the finished prints.

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[1] "Experiments on the prismatic spectrum show that all the colours of the spectrum, and all the colours in nature, are equivalent to mixtures of three colours of the spectrum itself, namely, red, green (near the line E), and blue (near the line G).

"The speaker, assuming red, green, and blue as primary colours, then exhibited them on a screen by means of three magic lanterns, before which were three glass troughs containing respectively sulphocyanide of iron, chloride of copper, and ammoniated copper.

"A triangle was thus illuminated, so that the pure colours appeared at its angles, while the rest of the triangle contained the various mixtures of the colours, as in Young's triangle of colour.

"The graduated intensity of the primary colours in different parts of the spectrum was exhibited by the coloured images, which, when superposed on the screen, gave an artificial representation of the spectrum.

"Three photographs of a coloured ribbon, taken through the three coloured solutions respectively, were introduced into the lantern, giving images representing the red, the green, and the blue parts separately, as they would be seen by Young's three sets of nerves separately. When these were superposed, a coloured image was seen which, if the red and green images had been as fully photographed as the blue, would have been a truly coloured image of the ribbon. By finding photographic materials more sensitive to the less refrangible rays, the representation of the colours of objects might be greatly improved."

In a trichromatic colour record, only one of the three colour elements can be represented in each negative image in its proper relation to the whites and greys.

Collen's idea was to make one complete negative image by superposing two single element records.

Baron Ransonnet, in Austria, is also credited with a crude suggestion of trichromatic photography, in 1865.

Louis Ducos du Hauron, in France, applied for a patent on the trichromatic principle in November, 1868. Du Hauron elaborated the idea very much, suggesting not only triple negative colour records, positive synthesis by triple lantern projection, and negative synthesis by superposed colour prints, but also positive synthesis by a photo-chromoscopic apparatus, and a process in which a single screen made up of juxtaposed coloured lines was substituted for three separate colour screens, and the operation reduced to the production of a single photographic image.

Du Hauron displayed extraordinary ingenuity, but, like Collen, he was misled by Brewster's theory of colour, and there were fatal defects in every method which he proposed.

One of his mistakes was in the assumption that pure colour screens should be used in the photographic analysis intended for positive synthesis, and that the same screens should be used again in the synthesis. Another was that negatives of a totally different character would be required for the purpose of negative synthesis by superposed transparent colour prints.[1] He recognised that the opacities of each of the three negatives intended for positive synthesis should represent a single colour element only, but not that they should be made through "colour curve" screens, for synthesis with "pure colour" screens. With respect to the character of negatives required for colour print synthesis, he made exactly the same theoretic mistake as Collen. He assumed that the opacities in each negative employed to make colour prints should represent two of the colour elements instead of one only; but instead of superposing two single element negatives, he proposed to allow two colour elements to act together in producing each negative.[2] For instance, he would allow both the blue and the yellow to act in the production of the negative for making red prints. The principle is exactly the same as that enunciated by Collen, and has the same fatal defect. Du Hauron himself saw that two colour elements could not be fully represented in a single negative in their relation to the whites and greys, but declared that in practice the defect was not as great as would naturally be expected, and made an ingenious but wholly inadequate argument to explain away the difficulty.

No amount of argument can nullify a fact.

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[1] "When the reader has read this book entirely through, he will recognise that, in the method described in Chapter IV., and which constitutes the direct method [for positive synthesis] . . . . each of these images is obtained by the exclusive passage, or sifting of the rays of the simple colour corresponding, through a space of the same colour. Proceedings are not the same for the method of inversion" [for colour print synthesis].—*From Louis Ducos du Hauron's treatise of 1869.*

[2] "Each of the images, instead of being obtained by a sifting of the rays of the corresponding simple colour through a space of that colour, is obtained by a sifting of the rays of the two other colours through a space of the double colour complementary to its own."—*Du Hauron in 1869.*

It has been asserted that Du Hauron's "binary" spectrum colours in reality correspond to the true "primaries," the descriptive term and not the colours themselves being erroneous. Writers who have made this assertion imply that I have misunderstood and misrepresented Du Hauron's work, but they are mistaken. Du Hauron not only plainly specified the "sifting of the rays of the two other colours," in contradistinction to exclusive sifting of the simple colours, but he distinctly said that yellow and blue objects must act alike (and as white) through the "green" screen, and, while admitting that a cobalt blue glass is better than a "violet"[3] one for the blue-red negative, he adds that "there is here presented a physical fact not in accord with the theory."

This error of Collen and Du Hauron dies very hard, and is perpetuated with supreme assurance by new writers every little while.

One fact which must not be ignored is that, although Du Hauron's theory was that the printing colours should correspond to his idea of the primary spectrum colours, red, yellow, and blue, the colours which he actually recommended are not very far removed from the minus colours of the true "primaries." His blue (prussian blue) is a greenish blue; his red (carmine) is a crimson red; and his yellow is a minus blue. The fact is, that sheer experience led him to depart very considerably in the right direction from the requirements fixed by his theories; but his conclusion, most positively stated, that the photographs for positive synthesis should be made by "exclusive passage of the single colour corresponding," while the photographs for negative synthesis should be made by "rays of the two other colours," is proof positive that he utterly failed to grasp the true relation between the two kinds of synthesis—the plus and minus character of the synthesis colours themselves—which certainly demands identical colour records for both purposes, and also that they shall be "single element," "colour curve" records.

Du Hauron's most important new contribution to the development of trichromatic photography at this period was his suggestion of a photochromoscopic device, of which I shall speak in another part of my lecture.

This may seem scant treatment of Du Hauron's early exploitation of the principles of trichromatic photography, in view of the fact that many people have regarded his early writings as the fountain head of this science; but I must take the facts as I find them, and his more or less natural errors do not in any way detract from my admiration of his prophetic spirit, and ingenuity, and fertility of imagination, which should be an inspiration to everybody who can read his original treatise on trichromatic photograhpy.

Du Hauron's first patent application was dated November 23, 1868, but his first printed publication appeared in "le Gers," March 11, 13, 16, 18, 20, 23, and April 1 and 6, 1869, and shortly afterwards in pamphlet form. According to his brother, Alcide Ducos du Hauron, he had communicated his ideas very fully, except in the matter of negative synthesis, in a mémoire transmitted to a French scientist and Member of the Institute, M. Lélut, July 14, 1862. It is a curious fact that this mémoire,[4] said to have been intended for formal presentation to the Institution, but which was not published until 1897, discloses several important ideas which are not to be found in any of Louis Ducos du Hauron's writings which were published prior to 1897, and which had meanwhile been published or patented by others. I shall have occasion to refer to this mémoire again.

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[3] He describes "violet" as a colour containing a large proportion of red, showing that he means purple, which is called for by his theory.

[4] "La Triplice Photographique des Couleurs et l'imprimerie," Alcide Ducos du Hauron, Paris, 1897, p, 450,

After Du Hauron applied for his patent, but before there had been any publication of his method, Chas. Cros, of Paris, proposed a system of trichromatic photography in a communication which appeared in "Les Mondes," February 25, 1868, and it is stated that he had described the same system two years before in a sealed mémoire deposited in the Academy of Sciences.

Cros also proposed both positive and negative synthesis. He at first appeared to accept red, yellow, and blue as the primary colours of light, and described methods of positive synthesis by triple lantern projection, by application of the principle of the zoetrope, by an arrangement of transparent reflectors, and by a prismatic device, employing in each case photographic positives from the original negatives, and red, yellow, and blue lights. For the production of colour prints he said the same negatives could be used, and the prints made in the "antichromatic" colours, "green, violet, and orange." Cros here clearly avoided the mistake of Collen and Du Hauron of trying to record two primaries in each printing negative, and it is remarkable that his printing colours, "green" and "violet" (purple), are just as near to the true printing colours, minus red, and minus green, as are true blue, and red. Afterwards, in the same article, he expressed the opinion that it might be better to make the negative by "green, orange, and violet" rays, and the prints in their "antichromatic" colours, "red, blue, and yellow."

Cros did not recognise red, green, and blue as the correct triad of primaries, nor that the "blue," and "red" or "green," and "violet," printing colours should be green-blue and crimson-red. There was no suggestion of anything so definite as analysis by colour-curve screens to be followed by positive synthesis with pure colours.

Cros' suggestions were generally of a somewhat speculative character, and he amusingly disclaimed any wish to submit himself to the "painful" labour which he could foresee would be necessary to arrive at a practical realisation of colour photography by such a system. He said he preferred to show the way, and to claim the credit after somebody else had done all the hard work. By this decision he proved himself to be, from a material point of view, one of the wisest men who ever attacked this problem, and, this being his position, he could afford to be somewhat vague—the more so the better; but some of his suggestions now appear wonderfully acute and prophetic, and are worthy of special notice.

For instance, Clerk-Maxwell and Collen both recognised the necessity for colour-sensitive photographic plates in order to practically realise their ideas and Du Hauron was content to give enormously prolonged exposures so as to utilise the extremely feeble colour sensitiveness of the ordinary photographic plates of that time. Cros, who also recognised this difficulty, pointed out that a photographic plate can only be acted upon by light which it absorbs. and said he thought it might be possible to make the plates colour sensitive. In this publication he clearly anticipated the "principle" of "optical sensitisers," as it was afterwards stated by Dr. Vogel. and, although he appears to have thought that the mere colouration of the film might serve to make the plates colour-sensitive by incorporating suitable dye-stuffs, it is a remarkable fact that he said a search should be made among a class of dye-stuffs, some of which actually do confer colour sensitiveness to bromide of silver plates!

Cros not only anticipated Du Hauron in the matter of actual publication, but was quite as fertile in original suggestions, and was, I think, more of a scientist, if less of a mechanic, than his rival.

I believe the names of Clerk-Maxwell, Harry Collen, Baron Ransonnet, Louis Ducos du Hauron, and Charles Cros complete the list of independent inventors of trichromatic photography.

Although Clerk-Maxwell was the first, there is in the original publications of Collen, Du Hauron, and Cros, internal evidence of independent conception of the idea.

Assuming that I have correctly set forth the essential conditions of success in trichromatic photography, and that I have fairly represented the publications of the original inventors, propositions by which I am prepared to stand or fall (I have recently studied the publications of Du Hauron and Cros most carefully), it follows that, brilliant as were the conceptions of these inventors, they failed to recognise requirements essential to success; and I do not hesitate to say that this is the true explanation of the discredit into which this idea had fallen after many attempts to reduce the methods to practice.

Du Hauron and Cros continued to try to perfect and exploit their ideas, but made very little real progress that I have been able to discover, except that Du Hauron made distinct improvements in cameras for making the colour records, and Cros in 1879 ("The Review of Games, Art and Sport," Feb. 15, p. 221) had definitely settled upon "orange, green and violet," as the "primary" colours of light, and stated that the prints should be made in pigments which suppress the respective primaries. After nearly twenty years (from the dates of Du Hauron and Cros' publications), although all the materials requisite to experimental success had long been at hand, the principle had not been confirmed by a single really successful result, and was apparently universally discredited.

Meanwhile Dr. H. W. Vogel, in 1885, stated as a "new principle," the negatives should be made by the same spectrum rays that are absorbed by the printing colours, and in the same proportions—in other words, that the "optical sensitisers," or colours spectroscopically identical with them, should be the printing colours. This was only another way of stating Cros' principle of printing in colours "antichromatic" or complementary to those which produced the negatives.

Dr. Vogel's statement of this "principle" disclosed no recognition of the relation which the negatives or printing colours must bear to the physiological analysis of the spectrum colours, thus missing the most vital point; and it is under no circumstances a true principle in trichromatic photography, but at best involves precisely the same error as the theory that positive synthesis should be effected by screens which transmit all the various rays which have acted to produce the respective photographic "colour curve" records. I hope I have made it clear that the true function of the printing colours is to subtract most efficiently (specifically) from ordinary white light the visual impression belonging to the respective colour elements, and that this is not effected by colours complementary to the correct photographic action. Notwithstanding the errors involved in Dr. Vogel's theory as applied to the trichromatic process (he also proposed a more complex analysis), the weight of his authority caused it to be generally accepted in Europe, and it is still a stumbling-block for many experimenters.

It was the acceptance of this theory that made Von Hubl, in 1898, declare that the Young-Helmholtz theory is not a suitable basis for a theory of three-colour printing, and that he could not see in what way it had indicated to me the correct printing colours.[1] Having no theory to guide him but Vogel's, Von Hubl worked out the details of a method which, assuming that he actually worked to his diagrams (see the "Amateur Photographer," January 19, 1894, p. 47), would reproduce the spectrum itself as three broad bands of equal and much diluted colour, with only very narrow spaces of blending between.

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[1] "Process Photogram," April 1898, p. 53.

Thus does false theory lead to error; and yet this method, which would completely break down upon the spectrum itself, is described in one of the technical journals, nearly six years after the publication of the principle of colour curve analysis, as "enriching our literature on this subject with the clearest exposition of the theory yet propounded!"

Dr. F. Stolze, of Berlin, published a series of articles treating of the theory of trichromatic photography, the date of which I cannot give, having never seen them in the original. Translations appeared in "Anthony's Photographic Bulletin" in September, October, and November, 1888, but it has been stated that the original publications appeared some years before. Dr. Stolze was probably the first to mention the Young-Helmholtz theory of colour vision in connection with this subject, and to point out that the most that could be expected of a trichromatic process was that it should more or less perfectly counterfeit most of the spectrum hues to the eye by colour mixtures physically different from the original colours.

Dr. Stolze's writings were not reproduced in English, and did not come under my observation until long after I had published similar observations, which he then claimed, very justly I have no doubt, to have in some measure anticipated. He treated of the subject only as applying to the production of colour prints, and did not formulate a definite principle, or recognise the practical bearing of the Maxwell measurements of spectrum colour mixtures, and his conclusions were distinctly antagonistic to hopes of practical success. My own experiments commenced early in the year 1878, and before the end of that year I had at hand all the material means requisite to success, such as perfect colour-sensitive plates, control of the absorption of colour screens, a method of producing half-tone process blocks for carrying out the idea in typographic printing, etc. Nevertheless, my results, even in lantern projections, were crude and discouraging. My theoretical knowledge of the subject was inadequate to discover the sources of error. Like Du Hauron, I gradually improved my results by sheer experience, but I am now perfectly convinced that complete success could never have been achieved by such a process of trial and error.

I became convinced that a quantitative analysis of the various spectrum hues in terms of three spectrum colours must form the basis of a successful method, and stated this principle and the method of its application somewhat clumsily in a paper read before the Franklin Institute in February, 1888.[1]

My analysis was, however, imperfect, and it was only after some reference to Maxwell's work in spectrum colour analysis which appeared in Rood's "Modern Chromatics" came under my observation, that I was able to perfect my method, and to clearly and perfectly enunciate the principle of colour-curve analysis and pure-colour synthesis, which I did in a paper read before the Franklin Institute in November of the same year.[2]

The application of this principle resulted in the accurate reproduction to the eye of the colours of the objects photographed—something which I then believed, and still believe, had never before been accomplished, and which probably never would have been accomplished by a trichromatic process without recogntiion of this principle.

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[1] "Journal of the Franklin Institute," Philadelphia, May 1888.

[2] "Journal of the Franklin Institute," Philadelphia, January 1888, p. 58.

I think I am correct in saying that the soundness of my theoretical exposition of the subject was soon recognised by Dr. Stolze, Victor Schumann, and Sir W. Abney, but that it was actively discredited, though without argument, by almost everybody who had previously become mentioned with the subject in the public mind.

Apparently unanimous condemnation by "practical experts" had the effect of persuading most people that my method must be wrong and my results tricked, and the wheels of progress continued to be clogged by voluminous writings which served chiefly as a negative means of discrediting an important truth.

I mention these facts in explanation of the aggressiveness which I have shown in my fight for recognition of this principle, and which has often been mistaken for a mere ebullition of egotism. I submit that, as a conscientious teacher, I could not do otherwise than maintain that by the application of this principle the problem of recording and reproducing colours by photographic analysis and optical synthesis was finally solved.

This course on my part has been all the more necessary because in some pretentious treatises, such as that of Alcide Ducos du Hauron, published in Paris as recently as in 1897, the principle of colour-curve analysis, to be followed by pure colour synthesis, is not even stated, and the principle of analysis is no more definitely stated than that the negatives should be made by "orange," "green," and "violet" light; and in the "melano-chromoscope" credited to Louis Ducos du Hauron, and only recently manufactured for sale, the photographs are supposed to be made through the same screens that are used for synthesis. Such loose methods may serve as playthings, but they no more represent scientific trichromatic photography than a child's use of a sixpenny prism represents the science of spectrum analysis.

Since this part of my lecture was in manuscript I have had the great pleasure of perusing a treatise on trichromatic photography by an English author, who has not only recognised the principle of colour-curve analysis and pure-colour synthesis, but has presented the subject in a most admirable manner. No doubt many who have found my own essays too concise and dogmatic in style to appeal to them successfully will find Mr. Tallent's fuller arguments and illustrations sufficiently convincing. It needed only the publication of such a treatise as this to put a period to my aggressiveness in a fight which has become distasteful to me.

Owing to the great number of factors in this solution of the problem of colour photography, a very great amount of work remained to be done in order to realise the conditions of successful every-day practice and general application.

Without special cameras for making the colour records automatically and special devices for accomplishing the synthesis, the method could never have much practical value. Both Du Hauron and Cros recognised this fact, and the former especially sought to provide for these requirements, and made some brilliant suggestions, without, however, meeting all the practical requirements.

The principal optical devices employed in carrying out the process in its ordinary forms are special cameras, triple lanterns, and photo-chromoscopes. Within the legitimate limits of this lecture I cannot describe these in detail, but will mention their characteristic features, and will give such references as will enable anybody to verify my statements and study the more intricate details.

A feature common to most of the cameras and photo-chromoscopes which have been proposed is the use of transparent reflectors, so disposed as to form three images with one objective or one view point when used as a camera, or to superpose the three photographic images upon the retina when used as a photo-chromoscope. Both Du Hauron and Cros proposed the use of plane parallel clear glasses for this purpose. Du Hauron went further; recognising that the two separated reflecting surfaces would double the outline of the images and produce confusion unless the positive images were optically at an infinite distance, he proposed the introduction, between the reflectors and the image, of convex lenses at exactly their focal distance from the images.

This arrangement, as originally conceived, was optically efficient as a photo-chromoscope, with the three images situate on different planes. In 1876 (British Patent No. 2873, July 22), he designed a camera involving the application of this principle, in which the three convex lenses were used as image-forming objectives, with a separate adjustable diaphragm for each lens, in order to equalise the exposures, and the use of convex lenses in front of the camera to parallelise the rays for near objects. As the rays can only be parallelised for one plane at a time, objects situate in all other planes would still be doubled in outline.

In a combined camera and photo-chromoscope the construction of which was first published in 1887, and which has been named the "melanochromoscope," the plane parallel glasses and convex lenses are so disposed as to bring the three images all on one plane;[1] but this construction involves the application of new ideas which I patented in 1884,[2] and a description of it is therefore not altogether in place at this point in my lecture. Waiving this objection to such an order of presentation, I will point out some of the defects of this instrument.

In the first place, it is optically imperfect except when used under certain well-defined conditions, because the convex lenses are at three different distances from the view point. The effect of this is to introduce different degrees of barrel-shaped distortion in the three images, when used as a camera; and while this does not prevent the instrument from superposing the same images in synthesis, provided that they are images of distant objects, it is incapable of perfectly superposing to the eye three equal images, and it cannot be used successfully for photographing near objects, because, the image-forming lenses being at different distances from the object, the three images will not focus alike either as to definition or size.

Any photo-chromoscopic device which is designed for analysis and synthesis with the same colour screens, like this one, I would class as a toy. Made as two separate instruments, one adjusted for photography and the other for synthesis, it could be made to meet scientific requirements for the reproduction of landscapes in miniature, but the difficulty and cost of obtaining clear glass reflectors with perfectly plane-parallel surfaces, the fact that the images are not available for synthesis by other methods because not identical in perspective, the impossibility of focussing near objects on all three sections of the plate at once, the impossibility of diaphragming separately for the three lenses, and the small angle which the images subtend to the eye, are all serious defects.

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[1] "La Triplice Photographique des Couleurs et l'imprimerie," Paris, 1887, p. 357.

[2] That he did not originally contemplate a one-plate arrangement is proved by the wording of his specification of 1876, p. 15, lines 48-54.

Another defect in the instrument as now constructed, due to the fact that the clear glass reflectors disposed at 45° angle to the axial ray have polarising properties, I shall describe later, also a defect of illumination of the image due to the relation of incidence and reflection with glass mirrors.

Charles Cros suggested positive synthesis by persistence of vision with a device constructed upon the principle of the zoetrope, and his brother, A. H. Cros in 1889, patented a device for carrying out this idea. Cros' instrument was of the three-step form characteristic of photo-chromoscope, constructed with two transparent and one silvered reflector, but the images were blended by means of a rapidly revolving wheel having four plane silvered and two clear open sectors, in combination with another plane silvered mirror occupying parallel planes disposed at 45° to the axial ray, and the wheel revolved by pulling a string wound upon its axle. This device was intended to be used also as a camera for making the three negatives through the same colour screens.

Attention is here called to the fact that in this device the reflecting surfaces were inclined to the optical axis in the perpendicular plane; and there is no publication of the idea of inclining them in the horizontal plane previous to 1894. Charles Cros, in a communication to the Photographic Society of France, in 1879 ("The Review of Games, Arts, and Sports," February 15, p. 221), in describing a transparent mirror device, expressly states that the mirrors are inclined at 45° to the sides of the box. Neither this nor any other persistence of vision device for this purpose has ever come into practical use.

The next conception of a photo-chromoscopic device was my own, for which I applied for a patent in February, 1892.[1] In this device, the two transparent and one silvered reflector are supplemented by additional silvered reflectors disposed in parallel planes, in such manner as to dispose all the images on one plane, and the doubling of outlines was avoided by employing slightly-wedged clear glass reflectors. This instrument could not well be made stereoscopic, and, although perfect in its performance as a monocular photo-chromoscope, it was too costly and delicate in its adjustment for commercial manufacture.

In March, 1894, C. Nachet, of Paris,[2] patented a device in which two of the images were blended to the right eye by the aid of a thinly-silvered or platinised mirror, and the third image, made from a different view point, was seen directly with the other eye. This was an attempt to make a combined photo-chromoscope and stereoscope; but, owing partly to the fact that very few people (if any) can successfully "blend" two primaries through two eyes, it was soon abandoned. This idea, first published by M. Nachet, is fully set forth in the mémoire attributed to Louis Ducos du Hauron as of the date July 14, 1862, but first published in 1897; nevertheless, it is credited to Nachet on page 360 of the same book in which it first appears as belonging to Louis Ducos du Hauron, in 1862.

In September, 1894. Carl Zink, of Gotha, published a description of a photo-chromoscope having three rectangular "steps," and two transparent and one ordinary silvered mirror, and a "cosmorama" lens. The new features in this device were the horizontal disposition of the steps, inclination of the mirrors in the horizontal plane, and all disposed to reflect from their upper surfaces. and an adjustment of angle to secure the best direct illumination of the reflected images. A horizontal disposition of the three mirrors had never before been published, although it appears in the Du Hauron 1862 mémoire already referred to, with one of them disposed to take the reflection from the under side. Zink's publication was anticipated by my application for a patent upon the same and several other important improvements in the "step" photo-chromoscope with transparent mirrors. My patent application, dating July 3, 1894,[3] discloses not only the arrangement shown by Zink; but (1) an efficient contraction to two steps instead of three, whereby the apparent area of the picture is nearly doubled, (2) the use of coloured glass reflectors, by which doubling of outlines is avoided, without the use of convex lenses or "thin silvering,"[4] and the construction and adjustment proportionately simplified, (3) a stereoscopic construction, whereby the illusion of reality is brought to perfection, (4) a modification by which the images are disposed in line upon a single plate.

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[1] U.S. Patent No. 475,084, published May 12, 1892.

[2] French Patent No. 237,394, March 29, 1894.

None of these ideas had been published before my dates of record.

Some months after the publication of my patent, Nachet claimed the same construction on the strength of a clause in his patent, which was to the effect that two transparent mirrors instead of one could be used in his three-image stereo-chromoscope. The natural inference from the wording of this clause was, that he meant one in front of each eye, the construction since adopted in the "Kromaz," and not an arrangement involving a totally different idea like my own. Even if it is assumed that he may have meant that two transparent mirrors could be used in front of one or both eyes, the fact that he so disposed his transparent mirror as to reflect from below, proves conclusively that he had then no thought of direct lighting of the reflected images and the use of a folding chromogram, which I patented, and which he reproduced, along with other details shown in my patent drawings, such as a tray base and strut for fixing the inclination, months after the publication of the patent.

Inclination of the mirrors in a horizontal plane, with the reflections taken from the upper surfaces, and the three images disposed in line upon one plate, patented and first published by me, also appears in Du Hauron's Melano-chromoscope.

As before stated, inclination of the mirrors in a horizontal plane, but at opposite angles, is disclosed in the Du Hauron 1862 mémoire. It is remarkable that the three-image stereoscopic construction patented by Nachet in 1894, a stereoscopic construction with three pairs of images, a two-step construction, methods of stereoscopic projection, and other ideas first made public by others, appear in this mémoire, and are first published as Louis Ducos du Hauron's inventions twenty-eight years after he was challenged by Charles Cros to show a record antedating Cros' sealed mémoire of 1867. Du Hauron's reply to this challenge appeared in "Cosmos," July 24, 1869, when he said, "I myself could have, at the conception of my idea [which he then dates back 'five or six' years] consigned its generalities to a sealed letter . . . . I gave up to the higher ambition to give to society and to France a system of heliochromy sufficiently elaborated," etc. This is his reply in 1869, seven years after it is now stated that he had prepared expressly for presentation to the Institute of France a mémoire of nearly 3000 words, describing a remarkably elaborate system, and that this mémoire was duly acknowledged and commented upon by M. Lélut, and read by at least one other member of the Institute, preserved all this time, and even now referred to as a "publication" in 1862. Although it may be inferred that his failure to get his mémoire presented to the Institute decided him to try to reduce the method to successful practice before trying again, it would seem most natural that he should have produced such conclusive proof of priority in reply to Cros, if he was able to do so.

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[3] U.S. Patent No. 531,040, published December 18, 1894.

[4] The possibility of employing coloured glass reflectors was first disclosed in my U.S. Patent No. 475 084, published May 17, 1892; but the particular relation of the colours of the glasses to the respective images was first published in the "Journal of the Society of Arts," May 19, 1893, p. 666. and patented in the U.S. in 1894. In his treatise published in 1897, Alcide Ducos du Hauron publishes this for the first time as a proposition of his own; and it is only one of many ideas which have been claimed by Du Hauron only after they had been published or patented by others. Even Clerk-Maxwell and Harry Collen are totally ignored in this book.

It is quite probable that the inconsistencies which I have noted may be satisfactorily explained away, but it seems proper, under all the circumstances, to raise the question, and I hasten to say that, for reasons well known to many, this can be done without questioning the integrity of Louis Ducos du Hauron. I don't think the question would have been raised in my own mind if I had not already regularly found my own published ideas reappearing in France as French inventions, dated back without evidence, and my own publications totally ignored.

My 1894 "two-step" photo-chromoscope (to which I have given the distinctive name Kromskop) has never been rivalled by any other form of viewing device, and has been finally perfected by two "improvement" inventions.

As originally constructed, it was found that the inclination of the transparent reflectors between the eye and the green image introduced such a distortion of that image that the red and blue images, reflected from plane surfaces, could not be perfectly superposed upon it. The reason for this can be readily shown by tracing the path of the rays from the top and bottom of the green picture to the eye, both direct and as changed by refraction through the inclined transparent mirrors, the amount of distortion depending upon the thickness of the glasses; but I need not take up time with such a demonstration here. Suffice it to say, that I soon found two ways of correcting this defect, both of which were rather unsatisfactory from the manufacturers's point of view. One was to employ slightly-wedged reflectors, so disposed as to correct the distortion, and the other was to introduce a similar distortion in the reflected images by attaching springs to the reflectors, so as to make the reflecting surface slightly cylindrical.[5] The first method, although efficient, called for weakly prismatic glasses, which cannot be obtained of sufficiently uniform accuracy by commercially practicable methods of grinding and polishing. The second method, although quite practicable in a commercial manufacture, is less perfect, and somewhat clumsy and troublesome. The final solution of the problem, a most obvious one when you come to think about it, was the introduction of a plane glass under the red image, equal in thickness to the sum of the two transparent mirrors, and inclined at the same angle.[6] This leaves the blue image uncorrected, but the error is only one-half what it would be in the red, and is of far less critical importance in the result, so that the image is now satisfactory to the eye. A kromskop made up without this compensation would now be instantly condemned.

Another defect which troubled me for a long time grew out of the fact that the coloured glass reflectors have polarising properties, while the silvered mirror which illuminated the green image did not have this property. With a grey sky as a source of illumination this did not much matter, but with a polarised blue sky the amount of light reflected by the transparent mirrors of the red and blue images varied with the angle of polarisation, so that an instrument which gave a bluish-white field when pointed to a portion of the sky near to the position of the sun, would give a yellowish-green field when pointed in a different direction, towards a part of the sky which appeared still bluer to the eye. The amount of light reflected from the silvered mirror was the same for all positions, but the amount reflected by the transparent mirrors sometimes varied enormously. There are half-a-dozen ways in which this defect can be lessened, but it is now eliminated by substituting a bundle of glasses for the silvered reflector in front of the green image.

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[5] U.S. Patent No. 622,480, published April 4, 1899.

[6] U.S. Patent No. 635,253, published October 17, 1899.

The fields of the kromskop also became green by reason of the light gradually darkening the red screen, and this defect has been remedied by employing a different colouring material.

With these and other detail improvements, the performance of the kromskop is perfect, and, although the public is slow to appreciate its value and importance, it is coming into use in the United States in the fields of entertainment, art, medicine, and commerce, and will, probably, be regarded as a necessity for many purposes in course of time, as it is the only means of producing perfect visual reproductions of thousands of objects.

Another form of the instrument, which I call the "miniature" kromskop,[7] is a modification of one of the plans of construction which I showed in the original patent, permitting of disposing the three images in a line upon a single plate. To simplify the construction, images of the kromogram are looked at obliquely, and the consequent distortion corrected by introducing a prismatic lens and a 7° prism. This construction is, practically, very much cheaper than anything else that has been proposed, and the images, although small, appear larger than in the far more costly melano-chromoscope, which Du Hauron has produced by grafting some of the same ideas upon his original conception. Probably, I should say, which Alcide Ducos du Hauron has produced by grafting some of my ideas upon his brother Louis Ducos du Hauron's original conception.

With the exception of the "miniature" kromskop, all the forms of photo-chromoscope can be adapted for making the photographic colour records; but not one of them is a desirable construction for a camera, and no one who knows all the requirements will waste his time trying to make them interchangeable. Even if the general plan was suitable for both purposes, it would be both better and cheaper to construct two instruments, one specially adapted for each purpose, than to provide all the substitutions and readjustments necessary to make a single one efficiently interchangeable. This conclusion has been forced upon me after making several interchangeable instruments myself, and examining those which have been made by others.

Moreover, the most efficient viewing instrument is the kromskop, with images in three planes, and no camera for making kromskop pictures will ever prove permanently satisfactory unless the three images are produced upon a single plate. I am so sure of this that I would feel justified in ignoring all three-plate cameras, but for the fact that the construction of some of them involves ideas which also enter into the one-plate cameras, and have had a part in their evolution.

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[7] "Journal of the Photographic Society of Philadelphia," March 1900.

The idea of employing as a camera an instrument essentially like the kromskop, with dark slides attached, is a favourite one with many; but, besides the objections to trying to make such an instrument efficiently and conveniently interchangeable, and the objection to trying to use three separate sensitive plates, it has some very serious optical defects as a camera. In the first place, the illumination of the images will be uneven, because the amount of light reflected from a transparent mirror varies with the angle of incidence, which differs for different parts of the cone from the objective, and the illumination of the images formed by rays reflected from the transparent mirrors is greatest just where it is weakest in the image formed by transmitted rays, or by reflection from a succeeding silvered mirror. In the second place, the proportionate illumination of the three images necessary to make the exposure required equal for the three plates cannot be readily controlled except by the use of compensating screens at the objective, which are almost certain to upset the selective absorption, especially if in the form of a party-coloured adjustable diaphragm aperture.

In the third place, the polarising properties of the transparent mirrors will, under some circumstances, introduce serious errors in the colour record. This is an important matter, of which I shall speak again. Here are five counts against trying to make an efficient camera out of an efficient photo-chromoscope.

Louis Ducos du Hauron divorced cameras and viewing instruments at an early date.[8] He originated the method of controlling the relative degree of illumination of the three images by employing three objectives and three separately-adjustable diaphragms, a principle which I once thought belonged to me; but he does not appear to have recognised the necessity of correction for unevenness of illumination across the images, which I accomplished by inclination of the diaphragms in the optic axis. This may appear to be a small matter, but the absence of such correction really constitutes a fatal defect.

The next step was to dispose the three images upon one plate, and this I did in 1892,[9] in trefoil, and in 1895,[10] in a line. In 1899,[11] I devised two new and simpler transparent mirror cameras disposing the images on a line. Hundreds of successful negatives have been made with the 1895 cameras; the 1899 cameras, although equally efficient and of much simpler construction, will probably never come into use, because already superseded by a still simpler camera of a different type, which I have since devised, and which, at least as a view camera, can have no rival.

Now, with respect to the defect introduced into triple cameras by the polarising properties of transparent mirrors of glass, a defect which nobody else has yet noted. Suppose that we have a camera with two transparent and one silvered mirror inclined in parallel planes one behind another in the optic axis, and that we are photographing a landscape view in which there is a portion of polarised sky. Naturally, the red image will be formed by reflection from the silvered mirror, and the blue and green images by reflection from the transparent mirrors. If the sky polarisation is at such an angle as to oppose free reflection from the transparent mirrors, the sky will be under-exposed in the blue and

[8] British Patent No. 297 3, July 22, 1876.

[9] U S. Patent No. 475.084, published May 17, 1892.

[10] U.S. Patent No. 564,889, published September 24, 1895.

[11] U.S. Patent 655,712, August 14, 1900, and another, not yet published.

green images relatively to the other parts of the view, but will be fully exposed in the red image; in the reproduction the colours will be quite incorrect. The same will be true if the red image is made by light directly transmitted to the plate through the transparent reflectors. Other complications arise if one of the transparent mirrors is inclined in a perpendicular plane, and the other in a horizontal plane. In either case, every coloured surface which has polarising properties may be expected to be falsely rendered.

There is a remedy for this defect, so far as it applies to polarised skies. By placing a quarter-wave mica film in front of the camera aperture the light may be circularly polarised before reaching the transparent reflectors, and it is then reflected like unpolarised light. The mica film should be in a revolving mount, in order to set it always with the axis at 45° to the plane of the incident polarised ray.

It is true that the setting of the quarter-wave film, which is correct for the sky, may be quite wrong for other polarising objects which appear in the view. Water and even foliage give polarised reflections, and kromskop landscape reproductions have often been criticised for defects due solely to the polarising properties of the transparent mirrors in the camera.

Transparent mirror cameras possess one special merit, which is that, when properly constructed, they give, with one exposure, absolutely identical view-points for the three images. This would be very important indeed when utilising large apertures or photographing very near objects; but no constructions, so far mentioned, of transparent mirror single-plate cameras permit of the employment of a large aperture, and they all require a good deal of knowledge and skill to properly construct and adjust.

Recently I have devised a one-plate transparent-mirror camera which can be made to fulfil all theoretical requirements with apertures as high as f-8, but its construction involves the employment of two large and very costly blocks of optical glass, and the angle of view is small, so that I still prefer for general studio work successive or alternating exposure cameras, one type of which I patented some years ago in England.[12]

We now come to the newest view camera; but, as leading towards it, I must go back to a suggestion made by Mr. Dallmeyer in 1891,[13] and which had the merit of great simplicity together with the defect of separate view-points. I refer to the use of rectangular prisms for dividing the light into three image-forming portions at the diaphragm aperture of the lens. This was a three-plate camera, and the use of rectangular prisms necessitated three separated diaphragm apertures in order to secure equality of illumination across the plates, the amount of separation of the diaphragm apertures depending upon focus of lens and angle of view. I used a similar arrangement myself in 1888, and a one-plate camera with triple aperture in 1890, but, although I published the fact in 1888 that I had a camera which made the three negatives simultaneously from "very nearly the same point of view," I cannot find that I published the construction.

In 1889[14] I modified this construction by substituting equilateral prisms for rectangular prisms, and thus obtained what may be described as a single, narrow, party-coloured aperture, giving practically a single view-point, and yet transmitting enough light to make kromskop pictures of landscapes with five-second exposures. Finally, by employing rhomboidal prisms, I projected all the images backward upon a single plate, and, taking advantage of the property of the higher refractive index of glass as compared with air to extend the focal point, so calculated the form and size of the prisms as to make the images identical in size and perspective upon one plane.[15] This camera, which, notwithstanding its small aperture, is as quick as any of the efficient transparent mirror cameras, except the new one last mentioned, is incomparably simpler and easier to construct and adjust than any other efficient one-plate triple camera ever devised, and is entirely free from the polarisation defect.

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[12] British Patent No. 3232, 1897.

[13] THE BRITISH JOURNAL OF PHOTOGRAPHY. July 10, 1891.

[14] U.S. Patent No. 632,573, published September 5, 1899.

This form of camera can be made stereoscopic, and it can also be adapted to work with a comparatively large aperture and single view-point for studio work by mounting the rhomboidal prisms on a rectilinearly vibrating support, so that the light is transmitted to the different images alternately in rapid succession. The movement of the prisms does not disturb the position or definition of the images, so no shutter is required, and the exposure is always going on in such a way as to make one as independent of fluctuations in the light as with the smaller-apertured view camera. All other alternating exposure cameras which have been devised require a shutter to cover the lens aperture during the movements, involving considerable loss of time in making the exposures. There are so many obvious ways of carrying out the idea with this limitation that they are not worth mentioning.

I have now come to the end of the list of triple cameras which seem to me to contain original features of practical value. The sliding back for making successive exposures upon a single plate still has the advantage of being much cheaper than anything else, and is efficient in a steady light with still objects. I make this in stereoscopic form with inverting prisms in front of the objectives, so that the stereoscopic pairs are reversed and transposed ready for mounting for correct vision in the stereoscopic kromskop.

I believe the first special triple lantern for colour projection was used by me in my demonstration at the Franklin Institute in February, 1888. On a single lantern body there were three complete optical systems, disposed side by side, with the objectives adjustable for register, and three lime lights. The three positives were mounted on a single wooden slide.[16] This lantern was made to fold very compactly, according to a principle which I patented in 1885,[17] and was adapted for ordinary dissolving views as well as colour projections.

In 1891 Albert Scott devised a quadruple projection apparatus with one source of light, one condenser to parallelise the rays, and four smaller condensers and four objectives to project the four images, which were of very small size. It is obvious that a triple-image apparatus can be made upon the same principle.

At the annual meeting of the American Association for the Advancement of Science, at Springfield, in 1895, I employed a "lantern kromskop," which was substituted for the ordinary lantern front in order to make trichromatic projections. In this device a small condenser parallelised the rays from an electric arc, and the light was divided into three portions by an arrangement of bundles of clear glass and silvered mirrors, after which it passed in parallel beams to three separate condensers, colour screens, and positives, coning into three objectives, adjustable for register. In front of these objectives, 15° prisms were used to separate the images in trefoil, and bring them back into register again, for demonstration purposes.

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[15] "Journal of the Photographic Society of Philadelphia," March 1900, p. 21.

[16] U.S. Patent No. 432,530, published July 22, 1890.

[17] U.S. Patent No. 338,074, published March 16, 1886.

An improvement upon this device is shown in my British patent, No. 5800, of 1897, in which swinging lens fronts, coupled to pivoted silvered reflectors, and operated by a lever, are substituted for the revolving prisms for separating the images upon the screen. I have also recently improved the construction and adjustments of this instrument.

It is obvious that, by adapting three condensers and three sources of light to any photo-chromoscopic apparatus, projections can be made, and this idea has been patented more than once; but it is far too wasteful of light to be worthy of consideration from a practical point of view. A single source of light is as efficient with the "lantern kromskop" as three sources of light can possibly be with any transparent mirror direct-viewing device, for reasons which should be obvious to anybody who knows enough of optics to trace the reflections in both instruments.

Having described the most successful and important methods of positive synthesis with three images, I now come to the idea of analysis and positive synthesis with a single image, which may be a sort of linear mosaic of the three separate images heretofore considered.

This idea belongs to Louis Ducos du Hauron, and is a brilliant conception, although of doubtful, or at least, very limited, practical importance. As a clever invention it ranks as high as anything that has been done in trichromatic photography.

The principle of this method was fully set forth in Du Hauron's 1868 patent, coupled, however, with his failure to recognise the correct triad of primaries, and the principle of colour-curve analysis, and pure-colour synthesis. He proposed to make a single negative image through a screen made up of fine juxtaposed coloured lines, alternately red, yellow, and blue, and then to view a positive from this negative through the same screen, making the red lines of the screen cover the lines which were made in the negative through red lines, and so on. It is evident that, with lines fine enough not to be separately perceived by the eye, the result should be a complete coloured picture, requiring no special viewing device to see it in its perfection.

Years after I had demonstrated the principle of colour-curve analysis and pure-colour synthesis, Dr. Joly applied the principle to this process, until then unknown to me. McDonough, in America, also revived the process, with red, green, and blue-violet colours, but not with a full recognition of the true principles of colour selection.

This process is exceedingly difficult to carry out successfully with coloured lines fine enough not to be offensive to the eye, and, when the images are made stereoscopic and magnified in the stereoscope, the line structure is positively distressing. It is best adapted as to effect for large window transparencies, to be seen from such a distance that the coloured lines are not separately perceived; but, it is said, that when so exposed the colours fade considerably in a little while.

It is very difficult, if not practically impossible, to make a correct selective line screen with from 300 to 600 lines to the inch—it is difficult enough to make such screens with superposed coloured films and glasses in separate squares—and it is doubtful if there are any suitable dyes for this purpose which are permanent. Such records can, however, be made by successive exposures through an opaque line screen, employing the same selective colour screens that are used in the kromskop cameras.[18]

In 1895, I thought of a method of making such negatives which permits of a single exposure for all three-colour lines, with an opaque line screen, but I had no use for it until last year, when I also devised a means of synthesis for such pictures without the coloured line screen, and I then applied for patents for both inventions.[19] I afterwards learned that Jan Szczepanik had applied for a patent for the camera in France, No. 287,709, of 1899, and that J. A. C. Branflll published a somewhat similar idea in THE BRITISH JOURNAL OF PHOTOGRAPHY, February 26, 1897. It is really, however, an application to this process of my original principle (1886) of screen "pin-hole images" of the lens diaphragm in the half-tone process.

The negatives are made through an opaque line screen in combination with a party-coloured lens diaphragm. The opaque line screen is placed within the focal plane, and so adjusted with respect to the parti-coloured diaphragm as to make a line record of the same character as with a coloured line screen, but with the advantage that the selective colour screens can be made up of superposed films and glasses with the same precision as kromskop camera screens, and the ratio of exposures can be perfectly controlled without the use of compensating screens. This method has one disadvantage as compared with the use of the selective coloured line screen, and that is, that it takes longer exposures to make the negatives, and it gives slightly separated view points for the three elements, introducing colour fringes on the edges of out-of-focus objects.

The most remarkable novelty is the method of synthesis without coloured line screens. For this purpose a simple optical device is employed, containing at one end three bits of coloured glass, and in the middle a pair of plano convex lenses. Between these lenses is glass, on the surface of which has been moulded in gelatine a series of prismatic lines. Right-hand prismatic lines refract to the eye light coming through the bit of red glass, left hand prisms' light coming through the blue glass, and flat spaces between transmit light from the green glass directly. To the eye, at the other end of the instrument, this prismatic surface has exactly the appearance of a coloured line screen, but the lines can be made finer, and the colours as pure as in the kromskep.

The positive line record when brought into register upon this surface, shows the colours with all the vividness and accuracy of the kromshop image,[20] and the whole outfit is simple enough to be made and sold as a superior scientific toy. I call this instrument the kromolinoskop.

Louis Ducos du Hauron proposed to make prints on paper by the coloured line tint processes, and MacDonough and his successors have tried to carry out the idea commercially. It should be evident that if the coloured line tint is made up of pure colours, as it must be for accurate results, the "whites" of such pictures would be much nearer black than white, as compared with white paper in the same light. In practice, very weak colours are used, and the result suggests a tinted photograph with overcast whites. Those examples which I have seen cannot be compared for quality with good trichromatic prints from three half-tone process blocks, and the practical difficulties of the process are far greater.

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[18] U.S. Patent (Macfarlane Anderson) No. 559,051, April 28, 1896, and U.S. Patent (F. G. Harrison) No. 578,147, March 2, 1897.

[19] U.S. Patent No. 648,784, published May 1, 1900, and another not yet published.

[20] One condition of perfect purity of colours in this reproduction is a "structureless" positive image. A fine ground glass laid upon the positive so mixes the coloured rays that the picture is converted into a perfect monochrome, and a very granular positive image degrades the colours by introducing a small amount of the same action. By supplementing the prismatic screen with an opaque line screen adjusted as in the camera, this defect can be remedied. but chloride of silver positives toned black should give perfect results with the prismatic screen alone.

Another and very ingenious method of positive synthesis is Professor R. W. Wood's "diffraction process." Professor Wood commences with an ordinary trichromatic positive colour record, such as a kromskop "kromogram," and prints the three images in register upon a bichromated gelatine or albumen film in diffraction-line tints, in which the lines are so spaced that the deviation for red in the print from the red positives corresponds to the deviation for green in the print from the green positive, and blue in the print from the blue positive. The resulting composite print is colourless, but, when viewed in a simple device suitably adjusted with respect to a single small source of light, diffracts to the eye a mixture of coloured lights which, theoretically, should be equivalent to the kromskop image.

By disposing the diffraction lines horizontally, which I suggested in order to readily permit of binocular vision, Professor Wood has been able to obtain stereoscopic reproductions, and the most serious defect in the picture at present is a tendency to crudity of colour, due to the fact that diffraction-line prints do not ordinarily show correct gradations of light and shade. I have proposed to overcome this difficulty by breaking up the diffraction lines by casting V-shaped shadows across the plate when making the diffraction print by means of an opaque line screen used according to my principle of gradating the lines in the half-tone process. I believe that the rendering of gradations of light and shade in the diffraction-line print can be perfectly controlled in this way. The prints can be made by placing the diffraction tints (on pellicles) in contact with the bichromated film, the kromskop positive over this, and the opaque line screen over the positive, with the direction of the lines at right angles to the diffraction lines. The opaque line screen may be so fine that the graduated breaks in the diffraction lines will not be noticeable in the result. Mr. Thorpe, of Manchester, has made diffraction prints with a single diffraction grating by disposing the lines at three different angles, and employing three sources of illumination.

The principles of trichromatic printing I have already set forth. It remains to make a few remarks about various methods of producing such prints.

The most perfect results have been obtained by printing in bichromated gelatine, either pigmented or afterwards coloured by immersion in dyes. Louis Ducos du Hauron made prints in pigmented gelatine and superimposed them in register upon a single support. With "colour-curve" negative records and correct printing colours, very good results should be obtained in this way, provided that the printing, and development, and pigmentation of the films are all in perfect harmony—conditions extremely difficult to secure.

In 1889 I made such prints by sensitising commercial gelatino-bromide celluloid films with bichromate, printing the three images as one, developing as one, dissolving out the bromide of silver, and then cutting them apart and dyeing by immersion in aqueous solutions of the dyes. This method offers the important advantage that the prints are equal in printing and development, and the colouration can be controlled. The finished prints were cemented together with Canada balsam between glasses. I communicated this method to others before publishing it myself, and it has since been credited to others, but I believe I was the only originator of it.

Lumière Brothers published a method which is an adaptation of the principle of the gum-bichromate process, and they have shown some excellent results in lantern-slide and stereoscopic transparencies, but the opinion has been expressed that most of their work was not done by the method which they published, but possibly by Woodburytype printing.

Dr. Gustav Selle has adapted a principle which had previously been employed for making monochrome prints upon fabrics. He prints in thin films of bichromated gelatine, washes out the free bichromate, and colours with dyes which are fixed in the film by the chromium oxide, which has been produced by the action of light. Reimmersion in water dissolves out the colour not fixed by the chromium oxide, and leaves a positive colour print, which is sometimes very good, but is apt to be rather too feeble for transparencies and to be tinted in the whites.

Attempts to reduce collotype trichromatic printing to successful commercial practice have wasted much time and money for a dozen printing houses since I uttered a warning and showed why the method is unsuitable. I do not know of anybody who is trying to do it now.

Trichromatic printing with half-tone process blocks was first carried out by me in 1881, and is now developing considerable commercial importance. Its development has been slow, partly because suitable paper, inks, and presses were not at first available. The almost universal adoption of the half-tone block process for typographic illustration has gradually brought about the necessary improvements in machinery, materials, and methods, so that, with correct principles to go on, improvement should now be rapid.

I now come to the consideration of some special methods and modifications, which at present appear to be more interesting than important, and must be treated briefly.

Du Hauron, some years ago, proposed the production of colour records in an ordinary camera by employing three transparent sensitive films superposed, one sensitive to violet light, another to green light, and another to orange light, with interleaved films of colour to control the action. The idea is a very ingenious one, and theoretically feasible; but, in practice, it will hardly be possible to make three transparent films of different colour sensitiveness which will either give the same scale of gradations in the developed images or require similar exposures. The problem of working to colour curves is also greatly complicated by this arrangement of superposed films. I am of the opinion that the production of colour records by my camera with the rhomboidal prisms will prove not only much less troublesome, but incomparably more reliable and satisfactory.

Mr. J. Wallace Bennetto has proposed a semi-dialytic system, in which the sensitive films for the green and blue images are superposed, and the plate for the red image exposed separately, in a camera having a single transparent reflector of red glass. This system has, to a lesser degree, the defects of Du Hauron's dialytic system, but with the added defects of uneven illumination across the plates, due to the use of a transparent mirror in a camera with a single objective, and the polarisation defect.

Charles Cros, in 1881, proposed a composite black film, made up of three or more fugitive colours, each of which would be bleached out by the action of light of the colour complementary to itself.[1] This is, theoretically, the most rational basis for a direct process of pigmentary colour photography that has ever been suggested, but it is doubtful if it can ever be practically developed and the colours fixed. This method has

[1] "Moniteur de la Photographie," 1881, p. 67.

been reinvented several times, and I gave it out as a new idea myself in 1891, together with some observations upon developing and fixing the prints. Otto Wiener has since elaborated the same idea.

In conclusion, although Maxwell's colour measurements furnished the key to a proper realisation and exposition of the principles of trichromatic photography, acknowledgment is especially due to Sir William Abney for his more complete investigations along the same lines, for many helpful observations, and for new methods of selecting and measuring colours, all of which are most valuable to the student, and should be taken at first hand. I give none of the references because everybody who is interested in this subject should read everything which bears Sir William Abney's name as author.

Acknowledgment is also due to Mr. Thomas Bedding for his appreciation of the importance of this subject, which led him to pay close attention to it for years, and finally to publish in THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC the best editorial review of the progress of trichromatic photography which had ever appeared in photographic literature.

I am aware that the incorporation of so much controversial matter in a scientific lecture is not generally to be commended, but the circumstances are, perhaps, somewhat peculiar, and I believe its bearings upon the subject will make it helpful in this instance. I am trying to promulgate what I believe to be important truths by the most effective means which I can command, and, if I have erred in judgment or in statement, I shall be only too glad of an opportunity to make all necessary corrections.

LIGHT FILTERS.

By Dr. Grebe, Jena.

[Translated from the "Photographische Correspondenz."]

A light filter may be described, generally, as any medium which absorbs light and allows any of the various kinds of light (wave-lengths) comprised in the entire spectrum to pass freely. The transmitted rays are called filtered light, and may belong to widely differing regions of the spectrum.

In its restricted meaning, however, only those media are called light filters which have desirable selective qualities, or, in other words, which may be used for definite purposes. It is a well-known fact that the selective properties of certain media are undesirable and even injurious. We need only mention the troubles due to absorption by the atmosphere, and various kinds of glass, minerals, etc. To all appearances they are colourless, yet they underlie certain problems in astronomy, and more especially astro-photography, micro-photography, spectro-photography, and other photographic processes.[1]

These absorptions mostly concern the very valuable region of the ultra-violet, on account of its great chemical activity, and we are much indebted to the classic work of Schumann,[2] Eder, and Valenta,[3] and H. C.

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[1] We include here many cases in which too much dye has been used in preparing the photographic film, thus inducing screen action.

[2] Unfortunately, Schumann's numerous works are widely scattered, and difficult of access. Much may be found in Eder's "Jahrbuch," which is an invaluable record, and I have used it extensively for this paper.

[3] "Denkschriften der math.-naturw. Classe." Vienna, 1894, vol. lxi.

Vogel[4] (and likewise to Buss[5] for his examination of dye-stuffs), which supply us with valuable conclusions, as well as the means of avoiding, as much as possible, the undesirable qualities of light filters.

The following remarks are restricted to light filters of desirable characteristics, and refer to their peculiar properties and applications.

According to the various methods of examining light, light filters may be classified as follows:—

1. Photographic.
2. Visual.
3. Bolometric.

A large part of the ultra-violet region of the spectrum (about 100 $\mu\mu$—370 $\mu\mu$) is very suitable for photographic examination, also the whole of the visual region (about 370 $\mu\mu$—750 $\mu\mu$) and a small portion of the ultra-red.

Ocular observation by direct means is, of course, confined to the visual part of the spectrum, whilst the bolometric method (developed by Langley and Rubens), in addition to the visual portion, also comprises an extensive tract of the ultra-red (about 750 $\mu\mu$—2800 $\mu\mu$).

Absorbents of the ultra-red have hitherto been of little practical value.[6] For this reason we shall omit them from further consideration. We will give a short description of the visual light filters, but our principal attention will be devoted to photographic light filters, which at present have become of the greatest practical importance.

1. VISUAL LIGHT FILTERS.

The history of visual light filters is connected very closely with the history of the theory of colour, and especially with the theory of colour absorption. The Egyptians were acquainted with coloured glass, but not till later was the preparation of transparent glass successfully accomplished. The properties of various media as light filters have since been applied in numberless forms in manufactures and the arts as shown in various branches of dyeing, ornamentation, painting, etc. They are especially exemplified in the application of stained glass to the decoration of churches, to theatrical purposes, and to signalling. Coloured lights have also been invented, as a substitute for light filters, for many purposes (Bengal lights, etc.).

So far as I am aware, the first conscious scientific application of light filters was made by the many-sided Florentine artist, Leonardo da Vinci (1452-1519),[7] who used coloured glasses for the analysis of mixed colours.

Light filters have since been used for scientific purposes, especially in the study of the theory of colour. I may mention as modern applications the use of filters for purposes of physical optics, and for spectro and polarimetric measurements. In physical optics they are used in studying the laws of light sensations, and for the selection of certain physiologically active light rays, etc. (coloured spectacles, chambre rouge, etc.).

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[4] Ibid. 1896, vol. xlvi.

[5] Reference in the "Photographische Correspondenz," p. 368. An original contribution to the spectrum analysis of some dye-stuffs, etc.—"Forschungsberichte," Munchen, 1896. See also Kruss: "The Absorption of Coloured Rays by Glass, and table of absorption of coloured glass." Eder's "Jahrbuch," 1890, p. 45. Eder's "Rec. und Tabellen," 4th ed. p. 70.

[6] Such filters have special application to micro-projection, where the heat rays must be eliminated as much as possible as a safeguard. Further details may be found in the recent works of Rubens.

[7] "Trattato della Pittura," Paris, 1651, chap. xxxi.

Light filters are also used extensively for technical purposes. From numerous examples we select a few which are mentioned as being peculiarly interesting.

Monochromatic filters are recommended for use with imperfectly corrected lenses (secondary spectrum) in order to focus the image sharply. In such cases coloured focussing discs are specially recommended (Francotte),[8] or, preferably, monochromatic spectacles. Beck[9] recommends green spectacles (phototone) for landscape photography, to facilitate a better estimation of the relative values of light and shade. Yellow filters are much liked as an adjunct to telescopes, field-glasses, etc., and agreeably modify the image. In America blue glasses have been inserted in field-glasses for the detection of the slightly yellow gases of smokeless powder, but I do not know with what success.

For viewing the so-called anaglyphs, spectacles with glasses of different colours are used. The anaglyphs consist of two images printed one over the other in complementary colours. Upon examination through spectacles of corresponding colours, each eye perceives but one image, that is to say, for each eye one image is eliminated. As both images are stereoscopic, they are united and seen in relief.[10]

Extensive application is also made of light filters in the synthetic methods of producing mixed colours. These are very numerous, and I mention the following:—

1. Additive three-colour projection (Maxwell 1861, Ducos du Hauron 1869, v. Bezold 1885, Ives 1888, etc.).
2. Additive four-colour projection (Scott, 1891, etc.).
3. Additive methods with party-coloured screens (MacDonough 1892, Joly 1894, Brasseur and Sampolo 1897, etc.). (Additive printing process, Intern. Colour Photo Co., 1899.) (Textiles, Szepanik, 1900.)
4. Subtractive methods for tri- and poly-chromatic positives (Ducos du Hauron and Cros, 1868, Vidal 1891, Ives 1895, Selle 1895, Lumière 1895, etc.).
5. Subtractive methods of tri- and poly-chromatic printing: Ducos du Hauron, 1869, Kraus 1890, Hofmann 1900, etc.); colour printing (Scholler, Kuhn, Henneberg, Watzek 1898, etc., gum bichromate: Vallot 1896, bleaching process; Vaucamp 1897, three-film process; Noack 1897, diazo process).
6. Subtractive methods of three-colour photo-mechanical printing: Le Blon, 1735, Gauthier 1745, etc. (Intaglio); Weishainpt 1835, Collen, Ransonnet 1865 (lithography); Husnik 1870, Albert 1876, Ulrich 1890, etc. (collotype); E. Vogel-Kurtz 1892, etc. (typographic).
7. Subtractive three-colour processes in dyeing and ceramics: Du Farg 1737, etc.; Vidal 1890, etc.

The colouring materials in all these synthetical mixed processes are to be regarded as light filters, although they are not usually so described, because their action depends exclusively upon their properties of absorption.

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[8] "Journal of the Royal Micro. Soc." 1892, p. 270. Eder's "Jahrbuch," 1895, p. 380.

[9] Eder's "Jahrbuch," 1895, p. 358.

[10] The process was worked out in 1853 by Rollmann for drawings (1858), by d'Almeida for projection; and, later, by Ducos du Hauron for photo-mechanical printing. Instead of light-filters, polarisers have been used for projection by Anderton, Boys, etc. For various applications of polarised light in photography, see Eder's "Jahrbuch," 1895, p. 406.

2. PHOTOGRAPHIC LIGHT FILTERS.

The ortho-, iso-, or pan-chromatic process has evolved from the efforts which have been made to render coloured objects photographically in their natural tone values. Nevertheless, the name only indicates the end which these processes have in view. We do not know of any process yet, of a purely photo-chemical nature, which in its qualities of colour sensitiveness perfectly corresponds to the photo-chemical processes of the normal human eye. The curves of sensitiveness for the spectrum show considerable elevation in the blue and violet in the case of all modern photographic preparations, without any exception. In order to obtain a correct, orthochromatic curve we must generally use a yellow filter as a means of compensation.

3. COMPENSATING FILTERS.

Fig. 1 is the schematic representation of the action of the compensating filters, c_1, c_2, and c_3, the sensitiveness of the process being *x y*.

The selection of the best possible compensating filter depends upon the nature of the process curve, as shall be shortly described. The process curve, as might be expected, also depends upon the quality of the light used.[11] This may be selected in such a manner that a compensating filter becomes superfluous.

Good compensating filters should not entirely eliminate any visible zone of the spectrum, as, for instance, c_2 and c_8, in fig. 1; they should only subdue, as in the case of c_1. On the other hand, the ultra-violet should be quite eliminated.

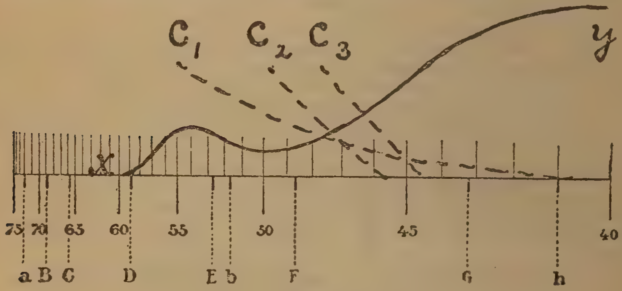

FIG. 1.

There are many known absorbents of ultra-violet, and they are partly characterised as very active fluorescent media. We enumerate a few:—

1. Solution of sulphate of quinine.
2. Solution of aesculin.
3. Solution of fluorescein.
4. Bisulphide of carbon (Miller, "Phil. Trans.," 1862, p. 861).
5. Petroleum.
6. Solutions of nitrates of alkalies. (Ervera, Eder's "Jahrbuch," 1900, p. 22).
7. Various kinds of glass, especially uranium glass, etc.[12]

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[11] Abney. Eder's "Jahrbuch," 1896, p. 128.
[12] Eder's "Handbuch," i. p. 281.

There is an exceptionally comprehensive literature relating to compensating filters. For nearly every one of the numerous organic yellow dyes some special preference is claimed. I give the names of some which are more especially recommended:—

Acridin yellow, auramin O, aurantia, aurin, brilliant yellow, chrysoidin, dymethyl-orange and methyl-orange, martius yellow, picric acid and salts, primulin, tropaolin, Victoria yellow. (As a handy guide to the organic dyestuffs, see "Tabellarische Uebersicht ueber die kuenst. org. Farbstoffe," Schultz and Julius, and Formanek's "Spectralanalytischer Nachweis kuenstl. org. Farbstoffs," Berlin, 1900).

Among the inorganic media, special mention should be made of the use of solutions of bichromate.

Ready-made yellow screens, yellow glass, etc., have been sold commercially for some time. C. Zeiss, of Jena, supplies them in three shades.

Cadett and Neall, Ashtead, Surrey, supply screens of two shades for their spectrum plates. The "Absolutus," or darker screen, gives the nearest possible correct rendering, whilst for shorter exposures the "Gilvus," or planer screen, is supplied, but is less correct.

Compensating filters are used for the reproduction of paintings, landscapes, portraits,[13] and scientific purposes (spectrum photographs, etc.).

Several filters may be used in combination, viz.:—

1. Simultaneously in superposition (subtractive combination).
2. Successively (additive combination).

Both methods have been recommended for purposes of compensation. Burchett[14] combines green and yellow, as a subtractive method, in front of and behind the lens. Vidal[15] and Hruza[16] use additive combination by changing the filter. It is evident that the field for combination is very extensive.

4. CONTRAST FILTERS.

If certain colours of the object are to be brought out and accentuated in the photograph, a filter complementary to it in colour must be selected. This is called a contrast filter.

These are mostly used in micro-photography, where very delicately

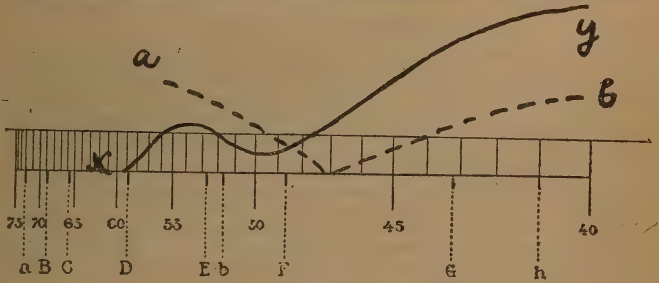

FIG. 2.

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[13] Bergheim recommends yellow studio blinds. Eder's "Jahrbuch," 1897, p. 303.

[14] Eder's "Jahrbuch," 1895, p. 382.

[15] Eder's "Jahrbuch," 1891, p. 437. Duchochois, ib., 1895, p. 437.

[16] Eder's "Jahrbuch," 1894, p. 53. Hruza combines in a cumbersome way three selective filters. See following reference.

coloured objects frequently present themselves, and they are likewise used in photographing clouds, when the blue sky has to be shown as a black background.

Fig. 2 shows the action of a contrast filter, combined with the process, x. y. the curve of transmission of the colour to be contrasted being b.

The literature of contrast filters is also exceptionally comprehensive. The discussion constantly turns upon the point indicated above.[17]

5. MONOCHROMATIC FILTERS.

In the strict acceptation of the word there are no monochromatic filters, but for the sake of simplicity filters have been so called that only transmit very narrow bands of the spectrum. According to the process used, very different filters will exhibit the same monochromatic action.

Monochromatic filters are mostly used for photographing with lenses forming a chromatic image (micro-photography,[18] astro-photography, etc.).

We enumerate some of the most important filters:—

1. Ultra-violet. This would be valuable for many purposes (Schumann), but none yet recognised.
2. Violet, Zettnow, iodide of copper, Eder's "Jahrbuch," 1893, p. 262; Gifford, methyl-violet + gentian violet + blue glass; methyl-green + blue glass, Eder's "Jahrbuch," 1896, p. 303.
3. Blue. Fehling's solution, ammonio-oxide of copper. In 1888 Lohse did not know of any blue filter that did not simultaneously transmit red, and concluded it was theoretically impossible to make one. Now many such are known.
4. Green. Zettnow, chromate of copper filter, Centralblatt fur Bact., etc., 188, p. 51; Gifford, benzaldehyde green + picric acid, Eder's "Jahrbuch," 1895, p. 217.
5. Red. Zettnow, oxide of copper glass, "Phot. Corr., 1889, July. Nagel gives a complete list in the "Biol. Centralblatt," xviii., p. 649.

This short statement shows how extensively the subtractive combination filters have been explored. Their use is of much value for the transmission of small bands of the spectrum. Landolt[19] makes extensive use of this method of polarimetric purpose.

6. PROTECTIVE FILTERS.

Protective filters are used for regulating the light of rooms where preparations have to be preserved from the action of light. Such filters, generally speaking, should only transmit light which has no effect upon the preparations in question, or only affects them after exposure for a considerable length of time. The colour of the filter should therefore be complementary to the actinic colours.

For most printing processes very pale yellow filters suffice; for Daguerreotype and the albumen process, the filter should be deeper; for the wet-collodion process, a pale orange filter; for the ordinary dry process, a deep orange filter; for the ordinary orthochromatic plate, a red filter; for Lumière's panchromatic plates, a dark-green filter. Cadett's spectrum plates (deep red) should only be exposed to the extreme red.

Cadett offers commercially "safe glasses," which are a subtractive combination of several dyestuffs.

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[17] Exhaustively treated by W. Gebhardt, "Phot. Rundschau," xiii. p. 43. "Intern. Phot. Monatschrift," vi. pp. 49, 73, 95, 113.

[18] See Neuhauss, "Lehrbuch der Micro-photographie," 2nd ed., pp. 66 to 74.

[19] Method of determining rotary dispersion by means of light filters. "Ber. der deutsch. chem. Ges," vol. xxvii. pp. 2872 to 2887.

Fig 5 shows the action of a protective filter in the case of process x y.

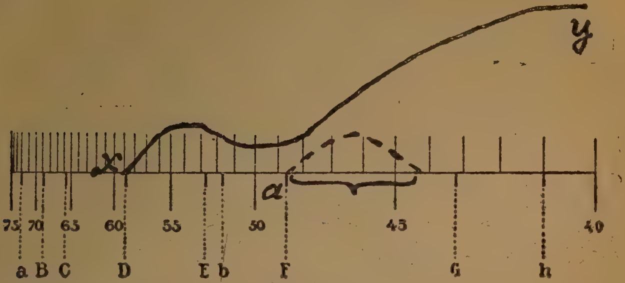

Fig. 3.

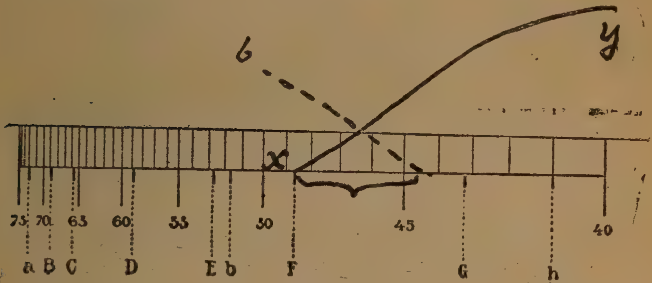

Fig. 4.

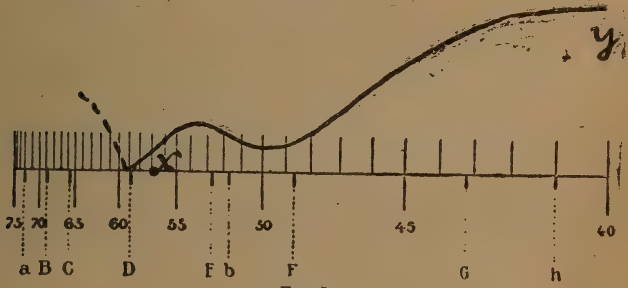

Fig 5.

Much has also been written upon this subject.

As subtractive combinations H. W. Vogel has recommended massive copper ruby + gold ruby glass; Miethe [20] copper ruby + cobalt glass.

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[20] Eder's "Jahrbuch," 1895, p. 380. For complete information concerning dark-room illumination, see Baynton, "Process Photogram," 1900, p. 142.

7. SELECTIVE FILTERS.

Combination filters, used in the indirect method of composite colour photography are called selective filters. Their purpose is for the selection of certain groups of colour from the object to be photographed. This process is called optical colour selection[21] (analysis, separation of colours, decomposition), in contradistinction to manual colour selection, which has been much used since Le Blon's investigations. Selection is generally supplemented by the second process of optical synthesis (colour reconstruction), the object of which is to reproduce the colour of the object as correctly as possible.

The optical synthesis may be done by two independent methods of admixture:—

1. The additive method of admixture (actual light mixture). The primary colour system of the three-colour synthesis, red, green, and blue-violet.

2. Subtractive method of admixture (mixture of colour substances). The primary colour system of the three-colour plates; pale blue, purple, and yellow.

The various synthetical processes are already mentioned under the visual light filters.

The history of optical colour selection has been traced back as far as the year 1861.

The English physicist, James Clerk-Maxwell, made the following statement on May 17, 1861, in a paper read before the Royal Institution:—

"Three photographs of a coloured ribbon, taken through the three coloured solutions respectively (three glass troughs, containing, respectively. sulphocyanide of iron, chloride of copper, and ammoniated copper), were introduced into the lantern, giving images representing the red, the green, and the blue parts separately. When these were superposed, a coloured image was seen, which, if the red and green images had been as fully photographed as the blue, would have been a truly coloured image of the ribbon. By finding photographic materials more sensitive to the less refrangible rays, the representation of the colours of the objects might be greatly improved."[22]

Twelve years passed before anything more was done in the direction of solving the problem enunciated by Maxwell. Meanwhile others occupied themselves with the process of selection set out by Maxwell.

The English miniature painter, Collen,[23] and Baron Ransonnet,[24] of Vienna, in 1865, selected red. yellow, and blue filters, but worked upon Brewster's incorrect theory of the three physical primary colours. Ducos du Hauron[25] in 1868, Cros[26] in 1869, and Husnik[27] in 1870, on the other hand used Maxwell's filters, red, green, and violet, which correspond with the Young-Helmholtz theory of the three primary sensations, which was Maxwell's starting-point. Maxwell's synthetic method was additive (trichromatic projection), but he also indicated the possibility of the subtractive method upon paper (three-colour printing). The work of Collen, Ransonnet, Ducos du Hauron, Cros, and Husnik was, on the other hand, principally in the direction of the subtractive method of synthesis.

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[21] In France, trichromatic photography is called "triple selection." Monpillard, "Bull. Soc. Franc," 1898, p. 535.

[22] Proceedings of the Royal Inst., "British Journal," 1861, p. 270.

[23] "Brit. Journ. of Phot.," 1865, p. 547.

[24] "Photo Corresp.," 1860, p. 199.

[25] Privileg. 23 Nov., 1868, No. 83,061. Eder's "Handbuch," vol. viii., p. 443.

[26] "Les Mondes," 1869.

[27] "Phot. Mitth.," 1870, p. 2, and "Phot. Corresp.," 1878, p. 1.

This work, however, was without practical result until 1873, when the problem was considerably simplified by Vogel's discovery of colour sensitisers. With the aid of the principle enunciated by Vogel, Ducos du Hauron obtained the first favourable results in trichromatic printing. He used orange, blue, and violet glass as light filters, and formulated his well-known theory of three-colour printing, "that the printing ink must be complementary to the corresponding filter."

This statement was attacked by many, more especially by H. W. Vogel, and is only correct with certain limitations, viz.:—

1. The use of a panchromatic process.
2. Perfectly transparent printing inks.
3. The expression "complementary colour" must be understood as meaning that which is necessary to complete the spectrum, or, in other words, the white light, resulting from the union of the two colours complementary to each other, must yield a continuous spectrum by decomposition.

These conditions were not then fulfilled. The process was merely panchromatic, the printing inks were impure, and the term "complementary colour" was loosely defined. Vogel made these defects, and the imperfections of the filters which were then used, the ground of his attack. In 1885 he enunciated a new principle as a better basis for three-colour printing,[28] from which reference to the filters is entirely omitted. This was as follows: "The printing inks in their relation to the spectrum must exactly agree with the sensitisers."

Hubl made the following correction in the second half of the statement: "Must exactly agree with the respective sensitised silver haloids." But the proposition expressed in this manner still remains only approximately true, especially if we consider the three processes as they are generally used (red, green, and blue sensitive plates). It may be confidently said that the division of the photographic process into three, which for a considerable time was inevitable, has contributed largely to the widespread confusion of ideas concerning the nature of colour selection. The general adoption of a single panchromatic process (as, for instance, the use of spectrum plates and compensating filters) would elucidate considerably the questions which still remain in suspense.

In the case of a panchromatic process there is no overwhelming reason for preferring Young's colour triad in the selection of the filters. Theoretically, an infinite number of colour triads are possible for the purpose. Moreover, on practical grounds, there have been frequent deviations from Young's triad. But in the present state of perfection of colour synthesis experience teaches that the best practical results are obtained by adopting Young's system. We shall therefore adopt it as the basis of our own remarks, and likewise the results of our predecessors, who have also worked upon the Young system. "Maxwell, Ducos du Hauron, v. Bezold, Ives," etc.

In 1888 we meet with an important rule for determining the properties of filters for three-colour selection according to Young's theory. Ives[29] postulates that the curves of opacity of the three negatives must agree with the curves of the corresponding primary colour sensations. These curves differ a little for various observers, and have been thoroughly investigated by Helmholtz, Maxwell, Koenig, Abney, and others. Ives's principle must therefore be restricted to the mean curve deduced from the colour sensations of a large number of persons of normal sight. Small deviations from these curves, of course, will always be unavoidable in practice, but they are not of very much importance. Ives therefore selects his filters and times his exposures,[30] so that the negatives conform as nearly as possible to this principle. The results Ives has obtained in this way are surprising, and appear to confirm completely the correctness of his principles. Ives uses a process panchromatically as correct as possible. He appears to have included the necessary factor of compensation in the selective filters, so that their properties can only be tested by photographic means. Optically, their colour qualities are different. I think it more expedient to keep selective filters distinct from those which are used for compensation. The selective filters must be tested by means of an apparatus for colour mixture to ascertain their correctness for the colour sensation values. Fig. 6 shows the process of three-colour selection with filters of this kind.

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[28] H. W. Vogel, "Phot. Farbiger Gegenstande," Berlin, 1885, p. 135.

[29] "British Journal of Photography," 1888 and 1889, p. 218; Eder's "Jahrbuch," p. 410.

The curves R, G, and B correspond to reddish-orange, green, and blue-violet selective filters, and agree with Young's curves of colour sensation. $x y$ is the curve of a modern panchromatic dry plate. C_2 is the correct compensation filter for the same. In the extreme red we see the small red error, which is generally present in commercial dry plates, but it is unimportant in practice. The dotted lines complete the actinic curve by addition of the ordinates. Like the preceding examples, this figure is purely schematic. The following table shows the colours of the selective filters and the corresponding colour syntheses.

The colour scheme for additive methods should be as homogeneous and intense as possible. For the subtractive methods, on the other hand, the colour scheme should be as nearly complementary as possible, and therefore composed of mixed colours.

Selective Filter.	Additive Colour Scheme.	Subtractive Colour Scheme.
Reddish orange	Red, about 630 $\mu\mu$	Pale blue
Green	Green, ,, 525 $\mu\mu$	Purple
Blue-violet	Blue, ,, 450 $\mu\mu$	Yellow

As homogeneous colours can very seldom be used in practice for additive synthesis, we are generally compelled to select mixed colours, which, however, should reproduce as purely as possible the shades of the primary colour scheme. However, such mixed colour schemes will always give much whiter colours in synthesis than homogeneous light. In fig. 7, homogeneous red, green, and blue light are represented by the thick vertical lines, and the mixed colours, which are generally used for the additive synthesis, by the dotted curves. (Ives's projection filters.)

The properties of selective filters can, of course, only be determined for constant conditions. The meaning of panchromatism is not absolute. It varies with the subjective sensation of colour brightness within rather wide limits, according to the absolute intensity of the light (Purkinje).[31] The process is also liable to variations due to difficulties of manufacture, according to the sensitiveness of perception of different observers. We have already mentioned that the compensating filter, the quality of the illuminant, and the period of exposure are of much importance. If all three factors are selected in due relation to each other for a single process, the defects might be so minimised that they would no longer be felt in practice. With three constant normal selective filters, and a normal process, etc., a safe basis might be found for all kinds of three-colour work. At present, however, there is frequently much difficulty in obtaining suitable colours for the synthesis, and one is compelled under such circumstances to make a compromise in the process of selection. It should be remembered, however, that colour manufacturers will soon be able to overcome these difficulties completely. Three kinds of glass have been found of suitable normal colours, in relation to the spectrum, for

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[30] The period of exposure is of great importance, but it can be determined by well-known methods.

[31] This is why the selective action varies considerably in the direct colour half-tone process with collodion emulsion and screens. The period of exposure in this case is very much increased, and the process dots are the result of over-exposure.

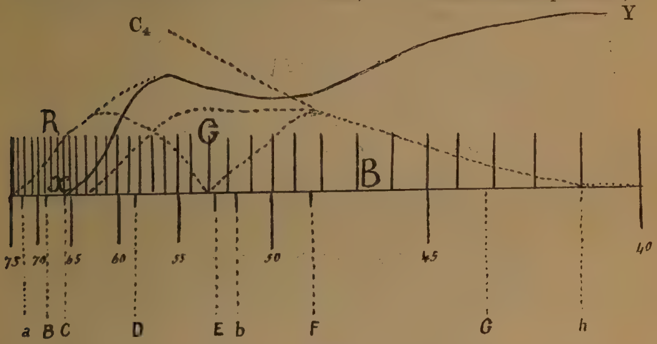

Fig. 6

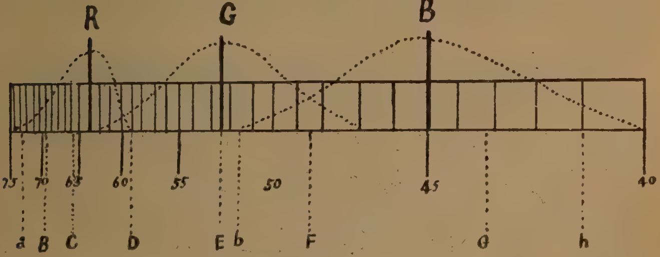

Fig. 7.

subtractive synthesis (by normal selection), and I have used them for the manufacture of a subtractive three-colour glass spectrum. These glasses are:—

1. Deep gold ruby glass;
2. Deep uranium glass;
3. Deep oxide of copper glass.

(Experimental samples produced at Jena.)

The conditions to be fulfilled by the selective filters are frequently expressed in a proposition of very general application—"Each of the three separate negatives must cut off two colours, and transmit the third."

This proposition has the merit of great simplicity, and is very valuable in ordinary practice.

Up to this point we have confined our remarks to three-colour selection, or filters.

Ducos du Hauron's[32] process of two-colour selection may be mentioned, in passing, as a curiosity. Scott[33] tried four-colour selection for additive synthesis in 1891. Eder[34] also drew attention to a similar process, based upon Hering's theory of sensation. These processes have hitherto been obstructed by the difficulty in obtaining suitable combinations of coloured inks for the synthesis. There is no theoretical objection in the way of a process based on any number of colours, but the bands of the colours used in the synthesis must be smaller in proportion to the number of primary colours. Three-colour synthesis is, however, already troublesome enough, on account of the bands being too broad.

There is no advantage in multiplying the number of primary colours. We may congratulate ourselves that in practice they are reduced to three.

TESTING THE PROPERTIES OF LIGHT FILTERS.

The testing of the light filter may vary according to the purpose for which it is intended.

The spectrographic method is the most practical and exact. The photographic action of a light filter in relation to any process may be determined in this way, likewise the purely optical effect, if a pan-chromatic process be used (spectrum plate and yellow screen, for instance). The writer always uses Cadett's Spectrum plates, with compensating filter, for his tests. The small error in the red may be neglected in practice (fig. 6). The exposures are made with a wedge-shaped slit as a guide to the comparative intensity. Other methods of testing light filters are used, and we may mention Lovibond's tintometer (British Journal of Photography, 1895, p. 712) and Abney's colour sensitometers.

Abney's first sensitometer consisted of a series of coloured glasses, and the second of a series of pigments upon discs. ("Photo. Journ.," 1900, p. 121.)

The photographing of colour charts is a method widely used, and a large number of charts have been constructed and circulated for the purpose. The following have come under my notice:—

H. W. Vogel, in the "Lehrbuch."

Cassell's colour chart, "Popular Educator," The British Journal of Photography, 1895, p. 23.

Hay's colour chart, "Process Photogram."

Warburg's colour chart, "Process Year-book," 1899, p. 13.

Hubl, "Dreifarbenphotographie."

Sanger Shepherd, "Process Year-book," 1899, p. 13.

Fischer and Wittich, Eder's "Jahrbuch," 1896, pp. 587-588.

J. Mayer, Eder's "Jahrbuch," 1896, pp. 587-588.

E. Kreutzer, Eder's "Jahrbuch," 1896, pp. 587-588.

Prang, Eder's "Jahrbuch," 1899, p. 616.

Cellarius, Eder's "Jahrbuch," 1897, p. 484.

Steinheil, "La Reproduction des Couleurs." Eder's "Jahrbuch," 1897, p. 484.

Harber's "Transparente, combinirbare Farbscala." Eder's "Jahrbuch," 1897, p. 484.

Schulz, "Transparente Scala." Eder's "Jahrbuch," 1899, p. 617.

A large number of older colour charts for the purpose of studying the theory of colour are well known. The transparent three-colour spectrum made by the writer, of three kinds of glass is very convenient for tests of this kind.

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[32] Eder's "Jahrbuch," 1897, p. 342.

[33] "British Journal of Photography," 1891, pp. 25, 325.

[34] Lecture, January 22, 1896. See "Phot. Cor.," 1898, p. 221.

THE TECHNICS OF LIGHT FILTERS.

With regard to the technics of light filters, they are very different, according to the special purposes for which they are required. In the positive processes coloured matt varnishes are used for lowering the action of light, also yellowish or greenish-yellow glasses. Yellow and red pigments are also applied locally, or otherwise.

In the negative processes the position of the filter is varied in the following manner:—

1. Position of filter behind the object (micro-photography). Instead of filtering the light emitted by the illuminant, direct coloured light is occasionally used, and in special cases it is combined with mono-chromatic filters. The spectrum may be used as a direct source of coloured light by cutting off the desired zone with a stop. (Count Castracane[35] and Piffard[36] used the region of the D line for correction of focal difference. Gifford[37] also gives some information concerning this method).[38]

Some kinds of Geissler tubes (hydrogen, mercury, etc.), the lines of which may in some measure easily be isolated by the aid of mono-chromatic filters,[39] are also employed.

The sodium flame, combined with a yellow filter,[40] gives homogeneous light, and other alkalies and alkaline earths have been used extensively. For particulars of the Lippich sodium light filter and the spectral purity of the sodium flame, see Landolt: "Das Optische Drehvermogen," second ed., p. 353 to 378.

Petroleum light was suggested by Schumann[41] in 1885 as a compensation filter. In reality, all sources of light are more or less coloured. Even sunlight, according to recent researches, is not quite white, but slightly reddish.

Flash lights with alkalies and alkaline earths, likewise metals, and especially the salts of copper, have been used in photo-micrography.[42] In closing the list we may mention pyrotechnic compounds, Bengal lights, etc.

Arc lamp carbons giving a yellow light may also now be had commercially. In using filters behind the object the perfect admission of the light is of less importance, especially when there is no need for economy, but if the light has to be directed with great exactitude a plane-parallel, optically homogeneous filter must be used. For unimportant purposes a flask filled with a coloured solution answers very well. The quantity of light absorbed is not determined by the size, but by the thickness of the filter. (Neuhass, l.c. p. 58.)

2. Position of filter in front of the object.—In practice the object is seldom lighted from in front with filtered or direct coloured light. Eder is opposed to this method.[43]

3. Position of filter in the field.—Immediately in front of the object. The light has to traverse the filter twice. Of no practical importance.

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[35] Nuovi Lincei, vol. xvii., 1864, March 6. Also Neuhauss, "Microphotographie."

[36] A suggested Improvement in the Correction of Lenses for Photo-micrography ("Amer. Journ. Med. Science," vol. cvi., 1893, p. 23.)

[37] "Journal of the Royal Microscopical Society," 1894, p. 164.

[38] Kohler, "Zeitscher. fur Wiss. Mikroskopie," vol. xvi. p. 1.

[39] "Fabry and Perot. C.R.," 1899, p. 1056: "Zeitschrift fur Phys. Chemie," 1899, part I., p. 169; Eder's "Jahrbuch," 1900, p. 520.

[40] Proposed by Gadeke as a dark-room lamp. Eder's "Jahrbuch," 1889, p. 80.

[41] Eder's "Jahrbuch," 1887, p. 311.

[42] Newcomb, Rohmann, and Galewsky, Eder's "Jahrbuch," 1893, p. 253.

[43] Eder's "Jahrbuch," 1896, p. 580.

4. Position of filter in the field.—Immediately in front of the objective. A very useful method. The filter should be optically perfect, so that the quality of the image may remain unimpaired.[44] With the filter in the field the distance between the lens and the object is increased, and it is necessary to focus with the filter in situ.

5. Position of filter in the diaphragm of doublet lenses.—This position is very generally used, but cannot be recommended for precise work, as the separation of the lenses is reduced by the introduction of a refractive medium, which sometimes affects the efficiency of the objective.

This method was recommended by Lohse[45] in 1888, and in the same year Jaffé[46] made a mechanical arrangement for inserting the filter in the diaphragm. Filters in rotating and sliding diaphragms have been made and recommended by Falleur[47] for their convenience. Abney[48] recommends cover-glasses coated with stained collodion for use in the diaphragm. (See Eder's "Jahrbuch," vol. viii. p. 485.)

6. Combined lens and light filter.—An orthochromatic objective of this kind was used by Harrison[49] as early as 1855.

In 1894 Burchett[50] recommended the use of stained Canada balsam for cementing the lens. Dallmeyer thought the idea worth considering commercially. Rodenstock[51] advertised bistigmatz with yellow glasses. Kampfer's[52] spherical light filters also belong to this class.

7. Polychromatic filters in various positions.—Pinhole filters, so called, have been recommended as a means of compensation, the centre of the filter being perforated for the admission of white light.[53] J. Rheinberg[54] has used various coloured filters for producing contrast in microphotography. The compound regulating screen patented by W. Donough[55] in England serves a similar purpose. Triple stops of different colours have also been proposed for colour selection.[56]

8. Filters behind the Objective.—For this position it is also essential that the filters should be optically worked, so that the quality of the image may not suffer. By placing the filter in the path of the image the back focus is reduced, and it is necessary to focus through the filter. This position is preferred for filters affected by the action of light, as they are protected by the camera.

Screen-holders for this purpose may be obtained commercially through Penrose[57] and others. Subtractive filter combinations have also been used simultaneously in front of and behind the lens (Burchett's combined screens[58]). Small cover-glasses coloured on both sides have also been used in the diaphragm slot (Gifford).[59] Under any circumstances it is preferable to place filters liable to fade behind the lens.

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[44] Edward and Handcock, Improved Screen-holders, Eng. patent No. 3290, 1897.

[45] Eder's "Jahrbuch," 1888, p. 361.

[46] Eder's "Jahrbuch," 1888, p. 473.

[47] Eder's "Jahrbuch," 1896, p. 362.

[48] Eder's "Jahrbuch," 1896, p. 361.

[49] Eder's "Jahrbuch," 1897, p. 300.

[50] Eng. Patent No. 24,487, May 19, 1894, "British J. of P.," 1894, pp. 67, 415.

[51] "Photographische Rundschau," 1900, p. 37.

[52] "Archiv fur Wiss. Phot.," 1899, p. 25.

[53] Gifford, Eder's "Jahrbuch," 1896, p. 174.

[54] On an addition to the methods of Microscopical Research, by a new way of optically producing Colour Contrast between an Object and its background, or between definite parts of the object itself. "Journ. Roy. Micro. Society," 1896, p. 374.

[55] "British Journal of Photography," 1896, p. 551.

[56] "Process Work," 1896, pp. 155, 195; 1897, pp. 3, 4, 24, 131; "Photo. Archiv," 1890, p. 250; Eder's "Jahrbuch," 1897, p. 487.

[57] "Process Year Book," 1898, p. 68.

[58] "British Journal of Photography," 1894, p. 67.

[59] "Photo Journal," 1895.

9. Filter in front of the plate.—This method was recommended many years ago by Schumann.[60] Small faults in the homogeneity of the filter are of less importance in this position than in the vicinity of the objective, because the deviation of the rays is less. Weissenberger[61] has recommended it for selection, and Cellarius[62] manufactures filter cells of this kind commercially. These filters are used in the dark slide, similarly to ruled screens. Dunmore[63] has also made the novel suggestion of coating the plate with stained collodion. The polychromatic ruled screens for the Joly[64] process are also used in contact with the film (selective party-coloured screen). The colours correspond to those of ordinary selective filters. Ruled screens of this description are also used in the McDonough,[65] Brasseur and Sampolo,[66] and the International Colour Photo. Co. processes.[67]

10. Use of the film as filter.—This modification has only been used occasionally, and the undesirable screen action of stained plates has generally been resorted to for the purpose. Dr. E. Albert[68] used picrates for staining his collodion emulsion films. Vidal[69] has used stained gelatine plates. Burton, Aristo, and Pike,[70] and latterly Smith, of Zurich, have also used the same method. Eder[71] is of opinion that this modification is not very advantageous. When using additive combinations of filters (changing screens) care should be taken that the size of the image is not affected. If the various media employed have different refractive indices, the correct thickness, D, may be found by the following equation:—

$$D = \frac{const.}{n}$$

With regard to the composition of the filters, they may be divided into three classes: gaseous, fluid, and dry filters.

1. Gaseous filters have seldom been used. Cornu employed fumes of bromine in spectral photography. Other coloured gases may be used in thick layers (enclosed in glass tubes with sealed ends).

2. Fluid filters are very useful. Nnmerous forms of receptacles, flasks, hollow lenses, cuvettes, etc., have been proposed, according to the position in which the filter has to be employed. If used before or behind the lens, the sides should be plane parallel and optically true. Landolt's filter flasks, which are very good for some purposes, are only plane parallel for the outer surfaces. Fritsch, Klonne and Muller, Steinheil, Warmbrunn, and C. Zeiss supply good cuvettes. The usual separation between the sides of a cuvette is 10 mm. For less important purposes two pieces of plate glass, separated by an indiarubber ring or piece of indiarubber tubing, may be used.

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[60] Eder's "Jahrbuch," 1891, p. 459.

[61] "Process Year Book," 1898, p. 68.

[62] Eder's "Jahrbuch," 1900, pp. 551, 680.

[63] "British Journal of Photography," 1894, p. 409.

[64] "British Journal of Photography," 1895, p. 600. For the preparation of screens of this kind, see "British Journal of Photography," 1897, p. 11; ib., 1900, p. 118. Eder's "Jahrbuch," 1897, p. 485. German patent granted to Otto N. Witt. Liesegang's application for patent No. 13,105. "Process Photogram," 1897, p. 76. American Patent 578,147, etc.

[65] "British Journal of Photography," 1896, p. 522.

[66] "British Journal of Photography," 1897, p. 217.

[67] "British Journal Almanac," 1900, p. 853.

[68] Eder's "Jahrbuch," 1889, p. 405; 1891, p. 163.

[69] "Moniteur de la Photographie," 1891, p. 163.

[70] Eder's "Jahrbuch," 1894, p. 378.

[71] Eder's "Jahrbuch," 1892, p. 393.

3. Dry filters may be prepared in many different ways. Plates of glass coated with stained collodion are generally used. For precise work the glass should be homogeneous and plane parallel, and the collodion structureless. For the selection of a suitable collodion for structureless filters, see THE BRITISH JOURNAL OF PHOTOGRAPHY, 1896, p. 722. Various additions are recommended for the purpose, such as ether[72] amyl acetate,[73] etc. In selecting the dye, not only the colour, but also the solubility, must be considered. If too much is used, the dye sometimes crystallises out. The plates should be coated with the collodion, as in the wet-collodion process. If the plates are stripped, thin coloured films can be obtained, which are very suitable for many purposes. Ives[74] has prepared stained films by floating a ring on mercury, and pouring collodion into the enclosed space. A cover-glass cemented to the film is of service for preserving fugitive colours from the oxidising action of the air. Various subtractive combinations may be made by cementing different colour filters together. The preparation of stained gelatine films is also very common. Dyestuffs soluble in alcohol are used for the preparation of collodion, but those soluble in water may be used with gelatine. For obtaining a very even film, the flat glass plate is levelled, the same as in the manufacture of dry plates. The addition of a little acetic acid is said to be of service. The gelatine may be coated upon the glass, and subsequently stained, by immersion in one or more baths, after setting. For less important work, a fixed commercial dry plate suffices.[75] Good serviceable stained films for various purposes may be obtained by stripping gelatine plates prepared in this way. The optical properties are improved by cementing cover-glasses to the films, and we strongly recommend it. Coloured varnishes have also been proposed in place of collodion and gelatine. Edwards[76] uses aniline blue as a stain for micro-photography. Stained matt varnishes are frequently used in printing processes. Lainer[77] uses fuchsin, eosine, aurantia, and asphalt; E. Vogel[78] chinolin yellow. Special attention should be paid to the solubility of the dyestuff. A long list of dyed fabrics, papers, etc., have been used for studio and dark-room illumination. Thick stained glass, of optically homogeneous quality, would be very valuable on account of its stability of colour and great convenience, but it is very difficult, if not impossible, to obtain of suitable quality in regard to colour. We also draw attention to the investigations made by the following writers concerning the properties of coloured glass:—Becquerel,[79] concerning the properties of absorption of the two kinds of coloured glass in common use. (See H. W. Vogel's Spectral analysis of earthly substances). Eder and Valenta[80] have also examined a series of experimental samples by means of the spectroscope. I hope to have the opportunity, on a future occasion, of giving an account of the very exhaustive examination I have made of some samples of coloured glass made at Jena.

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[72] Selle, Patent application, No. 11,956.
[73] "British Journal of Photography," 1892, July 22.
[74] "British Journal of Photography," 1899, p. 198.
[75] Vidal, "Brit. J. of Photo.," 1898, p. 255; Hubl, id., 1899, p. 676.
[76] Eder's "Jahrbuch," 1896, p. 303.
[77] Eder's "Jahrbuch," 1892, p. 223.
[78] Eder's "Jahrbuch," 1896, p. 534.
[79] "Ann. de Chimie et de Physique." 1843, vol. ix.; Eder's "Handbuch," i. p. 269.
[80] "Denkschrift der Math., Nat. Classe," vol. lxi., 1894.

SOME PATENTED INVENTIONS OF THE YEAR.

Selected and Condensed by the Editor.

AN IMPROVED SELF-ACTING TONING PAPER.

[Patent No. 19,683 of 1899.]

In self-acting toning papers the soluble salt of gold affected the toning in the fixing bath. Hitherto, says the patentee, Herr Raethel, chloride has been added to the emulsions, partly for chloridating the silver salt, and partly to influence the tone, of the prepared picture. In all cases the gold merely has been employed for the purpose to accomplish the toning of the picture.

The object of the present application is to provide a paper in which the gold not only forms the toning ingredient, but in which it also assists the production of the picture already before the toning.

The manufacture of my paper is based upon the knowledge that salt of gold in conjunction with, or in presence of, chloride of barium, is very sensible to the action of light, whilst chloride of gold ($\mathrm{AuCl3}$) alone is sensible to the same. My process is carried out in the following manner:—

I produce two solutions or emulsions sensible to the action of light, the composition of both being the following:

1. The emulsion of silver sensible to the light, for instance, consists of
   400 grains collodion (3 per cent.).
   16 grains nitrate of silver dissolved in
   20 grains of distilled water, and
   30 grains of alcohol.
   5—8 grains of a chloric salt, for instance, chloride of calcium, lithium, strontium or magnesium, dissolved in 20 grains of water,
   3 grains of an organic acid, as, for instance, citric acid, dissolved in 20 grains of alcohol.

2. The gold emulsion sensible to the action of light is produced in the following manner:—

To a solution of 0.1 grain of chloride of gold (AuCl^3) dissolved in 100 parts of ether-alcohol, about 5 drops of a solution of 1 grain chloride of barium in 40 grains of alcohol (40 per cent.) are added, and then the whole is thoroughly mixed with about 200 grains of collodion (3 per cent.).

Chloride of barium in presence of chloride of gold is easily and completely soluble in the mixture of ether-alcohol with pure alcohol (40 per cent.).

Both solutions remain inactive for about 12 hours, and then 80 grains of the gold solution are added to the above quantity of prepared silver emulsion, the whole being shaken thoroughly.

IMPROVED PROCESS FOR OBTAINING PHOTOGRAPHIC PRINTS.

[Abel's Patent No. 12,313 of 1900.]

The Actien Gesellschaft fur Anilin Fabrikation, of Berlin, have found a new method of producing photographic images by means of chromium dioxide, which remains in the prints after washing. This method is based on the fact, hitherto totally neglected in photographic practice, that chromium dioxide still possesses strong oxidising properties; hence it is able to transform certain colourless aromatic compounds into colouring matters of the most varied shades. This process is clearly distinguished from the process described by Lumière (compare Eder's "Handbuch der Photographie, II. Edition, IV. Vol., pp. 546-549), wherein manganese salts are employed, together with certain readily oxidisable substances, for the production of images. In the said process these images are produced with the aid of the unchanged salts, whence it follows that a negative will yield only negative prints.

The present process allows positive prints to be taken directly, because the production of images is not effected by the unchanged salts, but by their reduction products, formed by the action of light.

The following example illustrates this invention:—Coat unsensitised paper, as usually employed for photographic purposes, with a thin layer of an ammonium bichromate solution, prepared by dissolving 16 to 20 grammes of ammonium bichomate in 100 c. c. of water, with gentle heating. Dry the paper thus sensitised in the dark; put it beneath the negative, the image of which is desired to reproduce; expose to light for half the time necessary in the gum process. Wash the prints thus obtained; for this purpose, in order to remove quickly the unchanged ammonium bichromate, employ water, often renewed, and finally acidified with 1 c. c. of sulphuric acid in 1000 c. c. of water. Pass the print at ordinary temperature through a developing bath prepared as follows:—600 c. c. of water, 1 gramme of para-phenylenediamine, 1—2 gramme of sodium bisulphite. After a short time the image will make its appeaance, showing a dark brown colour; wash the print thoroughly, first with acidified, finally with pure water, and dry.

In the preceding example for para-phenylenediamine one of the following compounds may be substituted: diamethyl-para-phenylenediamine (melting point 40° C.); toluylene-para-diamine (melting point 65° C.); 1:5 naphthylenediamine (melting point 188 to 190° C.); para-amidophenol; methyl-para-amidophenol; ortho-para-diamidophenol; β-triamidophenol; pyrogallol; 1:5-dioxynaphthalene; para-amidodiphenylamine; para-diamidodiphenylamine; aniline; dimethylaniline. Any of these compounds imparts to the image a characteristic colour, so that prints of the most different tints can be produced.

As the ammonium bichromate solution is liable to be sucked up by the paper, suitable additions may be made in order to thicken the solution, and to cause the print to appear on the very surface of the paper. Additions for this purpose are, for instance, gelatine or gum, 6 grammes of which may be added to the solution prepared as described in the above example.

NEW OR IMPROVED METHOD OF AND MEANS FOR FOCUSSING IN PHOTOGRAPHIC CAMERAS.

[Adams and Watson's Patent No. 8099 of 1900.]

The present invention is as follows:—We employ a "triplet" or any suitable photographic lens adapted to our purpose: for instance, we may advantageously employ a photographic lens of the well-known character having two positive lenses and a negative lens, with the latter mounted in between the two positive lenses, or, if desired, the said negative lens may be placed in front. One or two of these three lenses we arrange and mount so as to be adjustable towards or away from the other lens or lenses, which are fixed. For example, we may arrange only the front lens (in such "triplet" photographic lens) in such-wise as to be adjustable in parallel planes with the other two lenses, which are fixed in the lens frame. This "triplet" (or other suitable) photographic lens is mounted in any suitable position in the camera relatively to the sensitive surface; and then, by adjusting said front lens of the triplet towards or away from the back lenses of said triplet, thereby the focussing can be effected; and then the exposure can be made through said lens, which remains exactly in the position in which has been set to obtain the desired focus aforesaid; the photographic lens employed being always of such a character that the adjusting of the lenses thereof towards or away from one another for the purpose of focussing upon the sensitive surface will not affect or materially affect the definition of the lens itself.

In carrying out this invention we have found it to be advantageous that the movement of one lens with respect to the other, as aforesaid, should be effected without rotation of either of the lenses with respect to the other; and, therefore, although this adjustment for the purpose of focussing can be obtained in a very simple and economical manner by simply mounting the lens to be adjusted in a ring or frame adapted to be screwed into or on to a sleeve or jacket containing the other lenses, this would not be such an advantageous method, as it would cause rotation of the one lens with respect to the other or others; and it is an object of our present invention to so mount the lens or lenses to be adjusted, that same can be moved towards or away from the other lens or lenses without rotation—unless equal rotation of all the lenses is obtained.

For the purpose of obtaining this adjustment of the lens or lenses with non-rotation thereof, we may mount the lens to be adjusted in a sleeve adapted to slide in an exactly parallel manner in or upon the jacket containing the other slide in an exactly parallel manner in or upon the jacket containing the other lenses, for instance, by means of straight slots and studs, tongues and grooves, or equivalent, and then we can impart endwise motion to said sleeve by any suitable mechanism; for instance, a stud or studs on the outside of said sleeve may engage with a spiral slot or slots in a rotatable outer sleeve or thimble held in a fixed position with relation to said inner sleeve, and adapted to be revolved around same, whereby endwise motion would thus be imparted to said inner sleeve carrying the adjustable lens; or a stud or studs on the exterior of said sleeve may be engaged by a suitably curved slot in a pivoted lever, or a suitably curved slot in each of two arms of a forked pivoted lever adapted to embrace said sleeve, whereby the slightest movement desired can be imparted to said sleeve to thereby adjust the one lens with respect to the others; or any other suitable mechanism may be employed for adjusting said lenses; it being understood that in all cases the adjusting mechanism employed must be of a character to allow the finest or slightest adjustment desired, as the actual movement required of the one lens with respect to the others for focussing purposes, according to this invention, is very slight indeed, and, consequently, means for very fine adjustment must be provided.

Description of the Drawings.

Fig. 1 illustrates a triplet photographic lens with the front positive lens made adjustable therein. Fig. 2 is local detail view. Fig. 3 shows alternative means for adjusting said front lens, figs. 1 and 3 each being longitudinal sectional views taken through the centre of a triplet photographic lens.

Referring to figs. 1 and 2, A is the cylinder or case in which are arranged and mounted in any suitable manner the fixed lenses *a* and *b*; the case A is enlarged at A^1 and its front end is provided with an external screw-thread A^2, and also is provided with longitudinal slots A^3 extending from the front end rearwardly (see fig. 2). The third lens, namely, the front adjustable lens *c*, is fixed in a ring or mount B^1

provided with a flange or flat top part B^1, and a collar or rearwardly extending part B^2, thus forming an annular space between the inside of said collar B^2 and the inner collar B, in which recess a coiled spring C is mounted, the other end of said spring bearing against a shoulder A^x, formed in the case A by the enlargement A^1. This mount B B^1 B^2 (within which the lens *c* is fixed) is arranged and adapted to fit snugly and slide within the enlarged end A^1 of the casing A, and, furthermore, said mount B is provided with pins B^3 (fixed on the exterior of the collar B^2), adapted to fix snugly in and slide within the longitudinal slots A^3 in said casing A, two such slots, A^3 and pins B^3, being provided, according to the arrangement shown in the drawings; but any other desired number of slots, A^3 and corresponding number of pins, B^3, may be employed as desired.

Fig. 1.

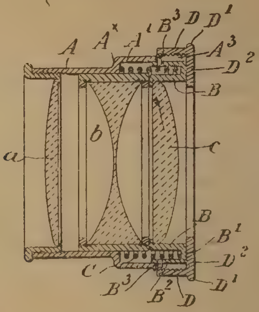
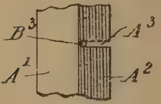


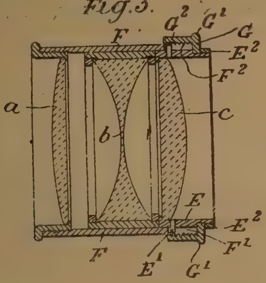
Fig. 2.



The mount B having been placed in position inside the enlarged end A^1 in the casing A, and the spring C placed therein (under compression), the outer screw-cap D (which may advantageously be provided with a milled edge D^1) is now placed over and screwed on to the threaded portion A^2 of the casing A, the flattened inside of the front part D^2 of this cap D bearing against the flattened portion B^1 of the mount B, and consequently, as the cap D is screwed up or unscrewed, the mount B and lens *c* therein will be moved towards or away from the fixed lenses *a* and *b*, while at the same time rotation of the lens *c* is prevented by the pins B^3 travelling in the slots A^3.

Referring to fig. 3, in this arrangement the lens *c* is fixed in the mount E provided with fixed pins E^1 adapted to fit snugly in and travel in the longitudinal slots F^1 formed in the casing F, which latter at its front end is externally screw-threaded at F^2: the lens mount E carries thereon the revolvable ring G, which may be provided with a milled edge G^1 and having an internally screw-threaded collar or portion G^2 adapted to screw on to the screw-threaded portion F^2 of the casing F, said ring G being held in position on the mount E by means of the locking ring E^2 screwed on to the exterior of said mount E after the ring G has been placed in position thereon, and in suchwise as to permit the ring G to be revolved upon and with respect to the mount E. If now the collar portion G^2 of the ring G is screwed along the screwed portion F^2 on the casing F the count E with the lens *c* fixed therein will be moved towards or away from the fixed lenses *a* and *b*: rotation of the lens *c* with respect to the other lenses *a* and *b* being prevented by the pins E^1 travelling in the slots F^1; no spring being employed or required in this case.

Fig. 3.



It will be obvious that any other suitable mechanism for moving the lenses towards or away from one another (preferably without permitting any rotation thereof relatively to one another) may be employed in carrying out the present invention.

IMPROVEMENTS IN FLASH-LIGHT APPARATUS AND CARTRIDGES FOR USE THEREWITH.

Giese's patent, No. 12,647, of 1900, relates to improvements in flash-light apparatus and cartridges for use therewith, and has for its object to provide more efficient means for confining or catching the smoke arising from the burnt powder in the cartridge and lamp; and also to improve the cartridge effecting the flash, which cartridge is employed in conjunction with the smoke catcher, and utilised for actuating same, or may be employed independently as a simple flash-light cartridge.

Figs 1 and 2 are front and side elevations respectively of the flash light apparatus in working position, the smoke catcher being open. Fig. 3 is a front elevation showing the smoke catcher closed. Figs. 4 and 5 are enlarged views of the cartridge as seen in figs. 1 and 2. Fig. 6 is a modified form of cartridge. Fig. 7 is a sectional view of the lamp used with loose flash powder, showing the method of igniting same and releasing the smoke catcher.

The apparatus consists of a hood, A, of any suitable textile material, accordian pleated, and supported upon a horizontal spindle, B, by bows, which are capable of moving around said spindle. The hood can thus be gathered together on either side of the centre bow, which is fixed, and be held thus by the cords, C, which pass through the ring or aperture D. The said cords C are hooked on to the cartridge E, and

Fig 1

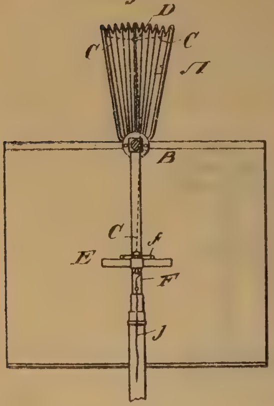


Fig 2

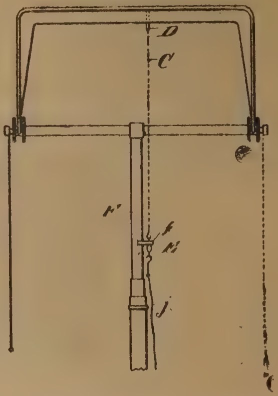


Fig 3

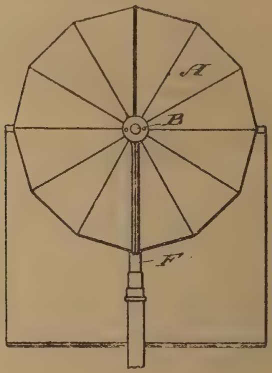
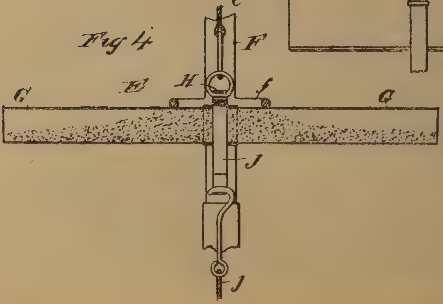


Fig 4



find resistance against the arms *f*, which are formed on the supporting upright F, through the case G carrying the flash-light powder.

The said cartridge, which, as before stated, can be employed without the smoke catcher, is more particularly shown in figs. 4 and 5, the case G being of considerable length compared with its diameter, and arranged horizontally. It is fitted with priming materials, either upon the strips H., or as shown in the modification, fig. 6, directly upon the case at *h*. In either form the ignition is effected through the rubbing action of the strip J, which is coated or provided with any suitable composition, by pulling the cord *j*. Or the ignition may be effected by impact in any convenient manner. The cartridge, when fired, is destroyed, and the resistance previously offered being thus removed, frees the cords C and allows the hood to expand circularly around the spindle B, and enclose the uprising smoke.

Fig. 5.

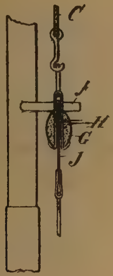


Fig. 6

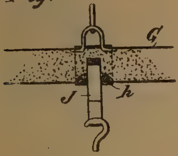


Fig 7

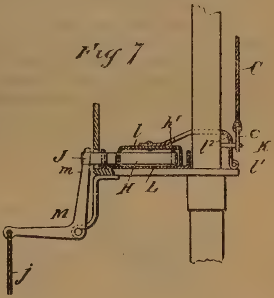


Fig. 7 shows the arrangement employed when loose flash powder is used. In this case the cords C are secured by a ring *c* to a fixed pin or projection K. The flash-light powder is strewed along a narrow tray L, and under a valve or trap *l* which is pivoted at l^1. The ignition is effected through strips H J provided with priming composition, similar to those shown in figs. 4 and 5. The strip H engages a pin h^1, and the strip J one arm *m* of the cranked lever M, to the other arm of which is attached the actuating cord *j*. On ignition, the explosion of the powder beneath the valve or trap *l* causes it to rise, the knee l^2 thus coming in contact with the ring *c* and dislodging it from the pin K.

IMPROVED MANUFACTURE OF A PHOTOGRAPHIC REDUCER.

[Abel's Patent No. 12,375 of 1900.]

The Actien-Gesellschaft fur Anilin-Fabrikation, of Berlin, have found that anhydrous sodium hyposulphite, when mixed with certain suitable salts, yelds a most powerful and stable reducer. But not all the salts, generally used in combination with common hyposulphites for reducing purposes, yield stable products when mixed according to this invention with anhydrous sodium hyposulphite. Potassium ferricyanide, for instance, is unfit for the said purpose, whilst potassium ferric oxalate is a valuable component.

According to this invention the new reducer is made, for instance, by intimately mixing 5 kilos of pulverised potassium ferric oxalate with 50 kilos of pulverised anhydrous sodium hyposulphite. From this mixture the reducing bath may be prepared in the most simple way by dissolving in an appropriate quantity of water a definite proportion of the mixture by weight or by measure.

IMPROVEMENTS IN PHOTOGRAPHIC BACKGROUNDS.

[Martyn's Patent No. 8810 of 1900.]

A suitable pattern consists of a framework G carrying rollers A A on either end, a suitable size being about 4 feet square; to the rollers is attached a continuous background B, a suitable length being about 20 feet. The background is caused to unwind from one roller and wind upon the other by means of a cord passing over both rollers in a groove or pulley, or by other suitable device. The framework G may conveniently have a circular disc attached rigidly to the centre, as shown in L. A pin or bolt is passed through the centre of L and the sliding piece O, so that the frame may be turned or rotated freely on the piece O. The stand to hold frame may be suitably formed of an upright standard C on a base D.

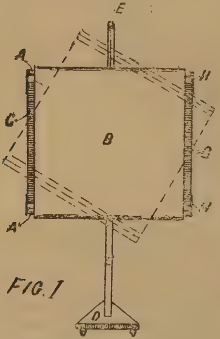


FIG. 1

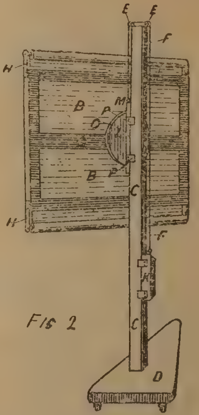


FIG 2

The sliding piece O is attached to a cord F, as shown at M, the cord then passing over pulleys at E. E, and being attached to a counterbalance weight K, which weight should be of the same heaviness as the frame and background. Both the weight and sliding piece may be provided with guide plates as shown at P to keep them in position on standard. The whole framework and background may then be easily moved up or down the standard to any desired height. The dotted lines in fig. 1 show the frame and background partially rotated.

To keep the frame at any desired point in the rotation a bolt may be passed through a hole in O into a hole, one of a series of holes, which may be bored toward the outer edge of L, or other suitable catch may be used.

A PROCESS AND APPARATUS FOR THE REPRODUCTION OR REPRESENTATION OF OBJECTS IN RELIEF OR INTAGLIO BY THE AID OF PHOTOGRAPHY.

[Kutzbach and Burkert's Patent No. 11,873 of 1900.]

Fig. 2 shows schematically how the object is photographed. Fig. 3 shows one form of the apparatus by which the photographical reproduction may be transformed—to a plastic one. If a plate A (fig. 1) with a design in relief is steadily drawn under a pointer *a* connected with a bell crank lever *c*, pivoted at *b*, a marking point *d* similarly connected to the other arm of the lever *c*, which we assume here to be bent at right angles to the plane of the paper, will mark on the said paper a line F, corresponding to the movements of the pointer *a*, the sum of which lines will produce an impression of a picture B similar to the relief plate A.

According to the well-known principle of inversion of movement, if the point *a* is replaced by a tool, such as a small cutter, needle point, or the like, it will produce the relief picture A, if the guiding point *d* is moved along and traced over the lines of the picture B.

Fig. 1.

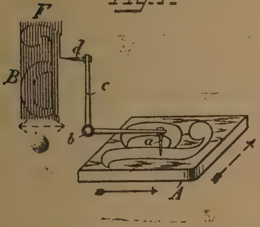
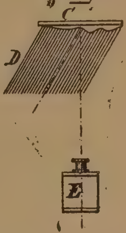


Fig. 2.



Such a picture B can be produced in a very simple manner. All that need be done is to produce a number of shade—or light—lines on the object, and to take a photographic view of it at the same time. It is immaterial of what shape the lines are which throw their shadow on the body to be reproduced. For the purpose in view it will be sufficient if, for example, a single line of light is passed over the object step by step, and a photograph taken of the object in the different positions the line occupies, these various photographs being taken on the same plate; or, as represented in fig. 1, in connection with the picture B, a number of parallel rays may be projected to produce a series of lines on the object, of which a photograph is then taken. The operation may be conveniently carried out by throwing a series of shade—or light—lines D on the object C (fig. 2) while the said object is being photographed by means of a camera E. In this manner a photographic view is secured, which corresponds with the picture B of fig. 1, and by means of which, when the guiding point is passed over the shade—or light—lines F, as the case may be, the cutter *a* will be so guided as to reproduce in the plastic comparatively soft material of the plate A, moving under it, a representation of the object shown in the photograph.

The parallel light or shade lines may be produced in a variety of ways. Thus, for instance, a net or series of rods or wires may be interposed between the object and the source of light, in such a manner that the parallel light or shade lines D are thrown on the object, producing thereon the peculiar broken lines F. Or parallel rays of light may be made to pass through a fine slit, the object being photographed in the dark, the light falling on it through the slit being caused to pass intermittently and regularly over the object, or passing continuously while the shutter of the photographic apparatus is intermittently closed and opened. As a very simple means for the purpose, a projection apparatus may be used, the plate holder of which is formed with a kind of grating, i.e., of a transparent plate provided with opaque parallel lines. When this is projected on the object, a kind of hatching or lining will be produced, corresponding to the picture B of fig. 1, and the object can then be photographed at once. In the present process it is an essential principle that the photographic views must be taken on a single plate, i.e., but one picture B is necessary.

The process forming the object of the present invention may be used for the production of whole or complete solid objects, such as busts or the like, in which case photographs will have to be taken of the object from several slides, and the several reliefs obtained from such views united to form the whole body.

It is also an important feature of this process that the picture B may be enlarged or reduced as regards dimensions, to any extent, by means of the mechanism such as schematically represented in fig. 1. Thus it is in the power of the operator to change the ratio of the levers, say, for instance, of the lever arm C, or to introduce adjustable parts in any part of the mechanism, by means of which the picture may be reproduced, reduced, enlarged, or displaced in any or in all directions. The cutter *x* may also be so arranged that the picture appears to be sunk, or in intaglio, instead of in relief. The process offers the advantage that the photographic view may be used directly as the guiding picture without any necessity of taking enlarged views or cutting it so as to form a reduced guide.

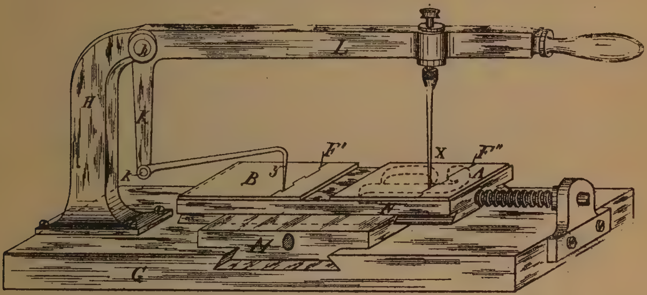
In order to be able to follow the lines F on the plate or on the picture with greater accuracy, the lines may, if desired, be etched into the plate or into any other reproduction of the same. In those cases in which it is preferable to follow with the guiding pin in a continuous line, such a line—say a spiral or a zigzag line—may be drawn on a glass plate, said line being then projected on the object, while the photographic view is being taken.

In the case of objects with strong reliefs, it will be found advantageous to make certain lines, say by breaking them, at regular intervals, say every fifth, thereby specially marking them, owing to which they can be easily followed in the multitude of lines.

The tracing device represented in fig. 1 may be easily adapted for the practical construction of a machine. In fact, the mechanism is somewhat similar to an engraving machine for the production of hatched relief lines in which the guiding point is formed as a tool for cutting away the material, while the point, otherwise the drawing point, is here used as the guiding point intended to be passed over the lines F. A practical form of apparatus is represented in fig. 3.

G is the base plate with a standard H supporting a bell crank lever K L pivoted at h. To the lever arm K is pivotally connected at k the guiding point y, while the cutter x is suitably arranged on the lever arm L. The base plate G is so arranged as to form a guide for a transverse slide M, which carries a second slide N, movable at right angles to the path of the slide M. If now the slide M is moved across the base plate G, while the lever L is so guided by means of the handle that the point y follows the line F^1, the cutter will reproduce in the block or plate A a line F^{11} the equivalent of F^1, but in intaglio and relief. After having finished the line the slide N is so displaced that the point y falls on the next line F^1 when the slide M is again moved, and so on until all the lines F^1 have been passed over, when it will be found that the cutter x has reproduced the object in relief.

Fig. 3.



In many cases, especially when it is intended to produce reduced reliefs, it will be found more advantageous not to move the picture and the work, and in this case the object is attained by providing the standard H and the bell crank lever K L with the necessary movements (in the opposite direction, of course), which are effected, according to fig. 3, by the slides M and N.

AN INSTANTANEOUS OR FLASH LIGHT CARTRIDGE FOR PHOTOGRAPHIC PURPOSES.

[Golby's Patent No. 10,850 of 1900.]

The flashing cartridge constructed according to this invention has an external form which is completely identical with the socket of electric incandescent lamps, so that it will fit into the holder of such lamps, and can be ignited by the lighting current.

This improved cartridge is represented in the accompanying drawings, wherein fig. 1 shows a side view, and fig. 2 a longitudinal section of the same.

In carrying this invention into effect the cartridge is made of precisely the same size and external shape as the socket for the bulb of the customary electric incandescent lamps, the metallic casing *a* of this cartridge being spirally wound or screw-threaded and filled in with insulating material *b*, in the lower end of which a metallic cap *c* is embedded. A wire *d* which is joined to the casing *a* runs through the insulating material into a recess formed at the top of the latter, and another wire *e* joined to the cap *c* likewise passes through the insulating material into the said recess. The upper extremities of the two wires which protrude into the recess at a little distance from each other, are connected by means of a filament *g*, around which flash powder *h* is placed, so that upon the passage of an electric current this filament will burn away or become incandescent, thereby igniting the flash powder.

FIG. 1.

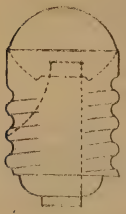
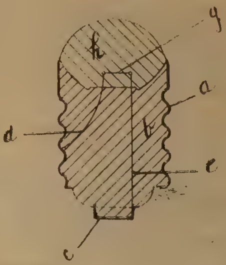


FIG. 2.



In order that the powder may be protected against external influences and have a better hold in the aforesaid recess, it is given a coating of collodion, gum, indiarubber or similar material, and has a quantity of some adhesive material added to it.

IMPROVED PHOTOGRAPHIC EMULSIONS.

[Lumiere's Patent No. 3736 of 1900.]

The different substances hitherto employed for obtaining sensitive matt surfaces, present inconveniences, which result from the action exercised by these substances upon the sensitive silver salts contained in the preparation.

The communicators have succeeded in avoiding these inconveniences by the employment of "kieselguhr," which, as is well known, is constituted of pure silica, and which, without action on the silver salts, gives a perfect matt character to sensitive photographic surfaces.

"Kieselguhr," after having been pulverised and freed from its impurities by chemical treatment and levigation, can be mixed with the emulsion at any stage of its preparation, either before the formation of the sensitive salts or at the moment of utilisation. The means for effecting this mixture will, naturally, vary according to circumstances; if it refers, for example, to gelatine emulsion, the following method of operation can be adopted:—The "kieselguhr," prepared as above described, being diluted in a certain quantity of water, a portion of gelatine is added to it, which is previously dissolved or swollen and intended to enter the emulsion. This mixture is then agitated and added to the emulsion prepared separately.

The employment of "kieselguhr" has the advantage of giving a very considerable matt character to photographic emulsions by the use of a much smaller weight of "kieselguhr" than that of any other substance hitherto employed. It is only necessary to add, to every litre of emulsion prepared in any desired manner, from 35 to 40 grammes of pulverised "kieselguhr," to obtain a complete matt effect, whilst it is necessary to employ about double this weight when employing other substances, such, for instance, as pumice stone.

TROUGH FOR DEVELOPING OR FIXING A NUMBER OF PHOTOGRAPHIC PLATES SIMULTANEOUSLY.

[Simonis' Patent No. 8869 of 1900.]

The apparatus consists of a tank or trough-like vessel *a* of glass (or other material unacted on by the solutions) of rectangular form and of internal dimensions corresponding to different sizes of plates generally used, the box being provided at the sides and ends with vertical corrugations or grooves *w* adapted to receive a number of plates *p* which are stood vertically in the transverse or longitudinal position within the trough, and rest by their lower edges upon a raised rib or ribs *m* at the

Fig. 1.

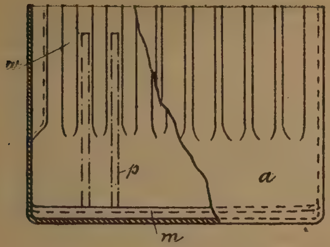


Fig. 2.

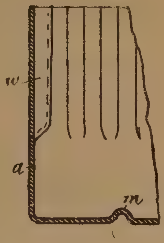
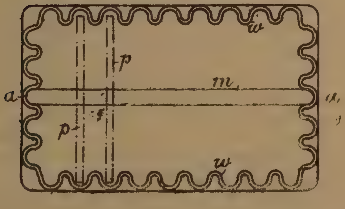


Fig. 3.



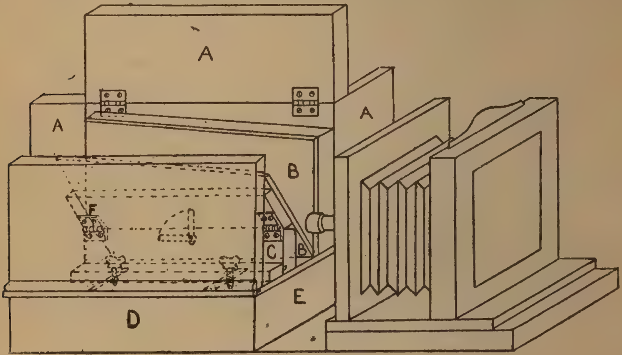
bottom, so that any precipitate or particles of dirt that may collect at the bottom of the trough will be clear of the plates. The trough is filled with the solution to above the level of the top edges of the plates, which are simultaneously acted on by the liquid.

PHOTOGRAPHIC DESIGNING MACHINE.

[Baskett's Patent No. 5618 of 1900.]

A machine for the production of designs by reflection, and their registration by the aid of a photographic camera, lens, and plates, the method by which this is attained I have indicated in accompanying drawings. The cover, an oblong box, the top or lid and the two ends hung by hinges, to open and fall back, throwing the interior open to the light, which may be daylight or artificial light, see A, A, A.

I place within at B, a reflector extending its full length. This consists of a silver surface mirror, or plated or polished metal, fixing the same to B, by springs of elastic bands, which will enable it to be tilted over to certain angles. A second mirror or reflector of the same size is attached to the sliding partition C, in the same manner. This sliding partition C is jointed lengthwise, and hung by hinges which enable the upper portion to fall back to any angle required, the mirror, or reflector falling with it and resting upon the upper part at the same angle.



By a slotted hole in the false bottom D, and a thumb screw through the fillet at the back of partition C, this partition will slide crosswise and be secured in place by the said thumb screw, and kept in an upright position by a button at back of same. By this means the mirrors working at any angle give reflections of any shape required, circles, stars, crosses, squares, and such like shapes whilst placed parallel they give borders or panels suitable for lace paper hangings or fabrics. At the end E, I place a photographic camera and lens, which registers by means of photographic plates, or films, each design that is reflected at the end F. By placing in the end F any design, or print, drawing, or opaque object, it is rendered by reflection into designs, entirely different from the original, and are at once registered by the camera and lens.

These negatives are then placed at F, with the light behind them, and the reflections again photographed. By this means an endless number of beautiful designs can be made, suitable for silversmith's work, lace makers, carpets, and for all trades where designs are required. And by using gas or electric light in front of the opaque objects, and behind negatives at F, all can be registered for the simple cost of the photographic plates.

AN IMPROVEMENT IN LENS MOUNTS FOR PHOTOGRAPHIC CAMERAS.

[Taylor's Patent No. 6029 of 1900.]

In a photographic camera provision is usually made for varying the distance between the lens and the sensitive plate or film, so that images of objects at various distances from the camera may be brought into focus upon the plate or film. In photographic lenses of the kind described in the Specifications No. 1991 of 1893, No. 22,607 of 1893, and No. 15,107 of 1895, the focus of the lens may be varied within limits by varying the separation of two of the three component glasses. This means of varying the focus by the lens may be used in order to focus the images of objects at various distances from the lens, and the lens as a whole may be kept at one fixed distance from the plate, instead of moving it, as is usual in the manner first described.

For the proper performances of lenses of this kind, it is necessary that the respective axes of symmetry of the component glasses be adjusted accurately to coincidence; and, in varying the separation of the glasses for the purpose described, it is necessary that this adjustment be accurately preserved: in other words, in moving the one glass towards and away from the other, it must not be tilted or displaced laterally.

Fig. 1.

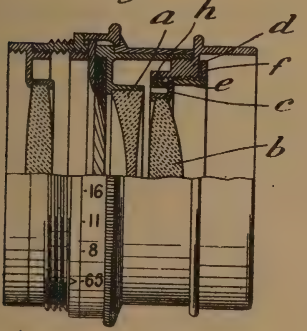
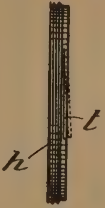


Fig. 2.



My invention relates to the mounting and moving of the glass without disturbing the coincidence of its axis with that of the stationary glass, as I shall describe. Referring to the accompanying drawing: Fig. 1 is a longitudinal section of a camera lens, and its mount of the kind described in the specifications above referred to, and fig. 2 is an elevation of the spring ring. *a* is the stationary glass and *b* is the glass which is capable of being moved a little nearer to or farther from the glass *a* for the purpose of adjusting focus. This glass *b* is fixed in a metal rim or flange *c*, having a cylindrical edge which is a close working fit within part of the lens mount *d*. This part is screwed internally, but the rim of *c* is not screwed. It bears only on the tops of the threads in *d*, and is provided with a feather or other means of preventing it from rotating. In order to move the glass *b* with its rim *c* to and fro I employ an accurately screwed ring *e*, working in the screw of *d*, and bearing against the outer face of the rim of *c*.

In order to prevent shake in the screw, and also to cause the glass *b* with its rim to follow the screw *e* when it is withdrawn, I put a spring between the rim of the lens and a shoulder in the mount *d*. Or there may be several blade springs *t* fixed on a ring *h* which is screwed into the mount *d*.

The ring *e* may be notched, and rotated by a key or other convenient means, but I prefer to mark it with figures to indicate the positions necessary to focus objects at various known distances. For this purpose, I prefer to attach adjustably to the screw ring *c* a nut or flange *f* screwed a tight fit to *c*, and sawn through on one side, so that it can be sprung open and screwed on to *e*, with sufficient tightness to remain where it is placed.

The flange *f* may be provided with stops to meet others fixed on the lens mount so as to limit the extent to which the flange *f* and ring *e* can be rotated. The object of attaching the flange *f* adjustably to *c* is that numbers of the flanges may be made with their indents already marked, and when the glasses of the lens are assembled in the mount the scale may be set at zero, and, at the same time, the separation of the glasses may be adjusted by turning the ring *c* in or out of the flange *f*.

IMPROVED MEANS OF OBTAINING INTENSE HEAT FOR LIME LIGHT OR OTHER PURPOSES.

[Munsterberg's Patent No. 8115 of 1900.]

Relates to improved means of obtaining intense heat, such, for example, as is required to secure the incandescence of the lime pencils used in lime lights, the invention being described for this purpose, its application for other purposes will be obvious.

Hitherto the generation of a flame of sufficiently high temperature to bring the lime rods or the like required in producing the Drummond lime light, to an intense white heat, was impossible except by means of oxygen, since all the combustible gases hitherto known, such, for example, as the hydrogen, hitherto employed for this purpose, could only generate sufficient heat for the purpose by being consumed in oxygen. The necessity, however, for using oxygen entailed a great disadvantage which considerably restricted the application of the lime light owing to the difficulty of preparing oxygen at the place of consumption, and the great difficulties in the way of conveying it by reason of the weight of the steel cylinders.

I have discovered that a suitable mixture of acetylene gas and air will generate such high temperatures as to raise the lime rods to a most intense white heat. As these mixtures of acetylene and air are in the highest degree explosive, the mixture must be prepared only in the flame itself, and in such a manner that the air is blown into the acetylene flame by means of a blower or similar appliance. The lime rods or the like may be replaced by rods of magnesia, zirconia, or similar substances, either alone or in suitable admixtures.

DIAPHRAGM SYSTEM FOR THE HALF-TONE PHOTO-ENGRAVING PROCESS.

[Penrose and Gamble's Patent No. 2942 of 1900.]

In making negatives for the half-tone photo engraving process it has become the practice to use apertures in the diaphragm of the lens which are either square, or are square with the corners extended in a horizontal, vertical, or diagonal direction, but so far no attempt has been made to make these irregular apertures bear a definite ratio to each other, as in the case of the ordinary round diaphragms used in photographic lenses, and it was therefore impossible to exactly calculate the ratio of exposures when changing from one diaphragm to another. It was also impossible with apertures of such arbitrary proportions to choose a diaphragm which would be proportionate to the screen distance, the screen ruling, and the focal extension of the camera. Further, when the corners of the apertures were extended to promote what is termed joining-up of the half-tone dots, or, in other words, the spreading action of the light behind the lines of the ruled screen, which is used in front of the sensitive plate, there was no defined ratio of the corner extensions to the central aperture of the diaphragm, and it was therefore impossible to determine how much joining-up an extended aperture would give.

The present invention is designed to remove these difficulties by providing a set of lens apertures which facilitate the calculation of exposures and screen distances when using square or extended-corner diaphragms, and also to provide for a joining-up, which will progress at an exactly proportionate rate to the general exposure obtained with the plain square opening.

For the purpose of carrying out our invention we cut on blank pieces of metal, which fit into the diaphragm of the lens, a set of apertures, each of which is half as large again as the preceding smaller one. The respective apertures are, therefore, in the ratio of 1½:1, which will accordingly be the ratio of the respective exposures.

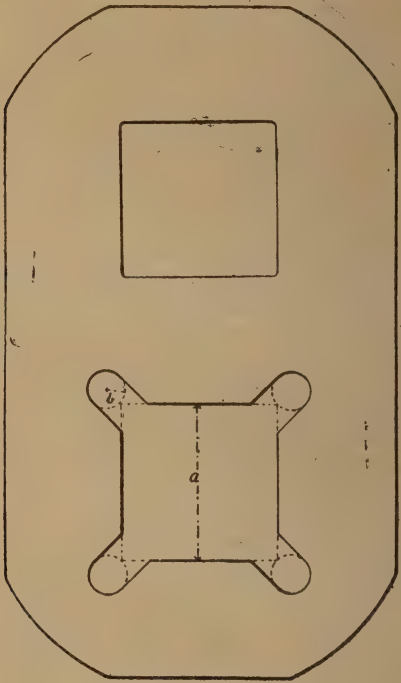
The linear and areal dimensions of a set of apertures suitable for the smallest or the largest lenses commonly in use have been determined as follows:—

DIMENSIONS OF APERTURES.

Serial No.	Linear.	Area.
	inch	inch
1	·204	·0416
2	·250	·0625
3	·306	·0936
4	·375	·1406
5	·460	·2116
6	·562	·3158
7	·689	·4747
8	·844	·7123
9	1·034	1·0691
10	1·266	1·6027
11	1·550	2·4025

In practice the cutting is done within a limit of error of .01 inch. For large lenses the first four or five diaphragms in the above series would be too small; whilst for small lenses the last four or five would be too large. Hence we do not use the whole series for every lens, but select six which are most suitable.

In making the extended corners to facilitate joining-up we find that the best proportion of the extension to the main area is determined by striking a circle with a radius equal to one-eighth the side of the square, that is to say, one-eighth the linear dimension of each aperture. In the accompanying diagram *a* being the linear dimension, *b* is the radius of the extension.



In order to neutralise diffraction effects, we have found it an advantage to leave the corners rounded, as shown at *c* in the diagram accompanying this specification.

A further particular feature of our invention is the cutting of two apertures, viz., the plain square, and the extended cornered square on the same piece of metal which forms the diaphragm, so that, when changing the aperture from one shape to the other (which has usually to be done in the course of exposure), we have only to reverse the diaphragm end for end. This saves half the number of pieces which would ordinarily be used. We may, however, cut the apertures on separate pieces of metal without affecting the utility of our system.

The cutting of the apertures is conveniently done on a profiting or pantograph machine from standardised patterns, but may be done in any other appropriate way.

IMPROVED FINDER AND LEVELLING DEVICE FOR PHOTOGRAPHIC CAMERAS.

[Lischke's Patent No. 14,473 of 1900.]

The invention has for its object to provide an improved finder and levelling device for photographic cameras which shall enable the position of the air bubble in the spirit level to be observed by the operator by means of a mirror in such a manner that a horizontal position of the camera can be ensured even when the camera is being held by the operator, at or above the level of his eyes, for example, in taking a picture over the heads of a crowd, or over a hedge or paling.

In this finder and levelling device the mirror above referred to for enabling the position of the air bubble in the spirit level to be observed by the operator may be made in the form of a narrow central strip, or as a round mirror. When made in the form of a narrow central strip, the mirror will only show the air bubble in the spirit level when the camera is being held in the desired horizontal or approximately horizontal position.

The mirror is made adjustable so as to be capable of being set within certain limits to any desired angle to the spirit level. It is also capable of being fixed in any position after adjustment; for instance, the mirror will have to be set at a larger angle (say 70 to 80 degrees and over) to the spirit level when the camera is held at the level of the eyes of the operator, whilst if the camera is held at a greater height, the mirror will have to be set at a much smaller angle, say, 45 degrees and under, in order to enable the operator to observe the position of the air bubble in the spirit level.

In carrying out this invention, the spirit level is, preferably, enclosed in a case and fitted with a lid or cover; the mirror may conveniently form part of or be formed on the inside of the said lid or cover. The said lid or cover may also be provided with a sighting notch by means of a foresight, which may consist of the pointed upper end of an arm pivoting on or hinged to the mirror, or of a frame or diaphragm fitted with web or crossed threads, and located in front of the spirit level and mirror, and capable of being turned up and down as required.

When the webs or crossed threads are used, the aforesaid arm is dispensed with, and the sighting is effected by means of a back-sight notch in the mirror or in the lid of the spirit level, in the same manner as when a fixed fore-sight is used.

In using a round mirror having a diameter of 15 millimetres, and a spirit level in a box of also 15 millimetres diameter, the reflected image of the air bubble in the spirit level is only about 5 millimetres distant from the sighting point, so that in sighting, the reflected image of the air bubble will be sufficiently distinct.

In holding the camera in an elevated position, as, for instance, in taking a photograph over the heads of a crowd or over the top of a high hedge or paling, the combination of mirror and spirit level enables the camera to be held in an exact horizontal position by simply adjusting the position of the camera in accordance with the image of the air bubble in the mirror, even though no use can be made of finder proper, that is to say, even though no sight can be taken through the notch in the top of the lid of the spirit level in connection with the webs or crossed threads.

In the accompanying illustrative drawings, figs. 1 and 2 are respectively a side elevation and a plan of one form of the sighting and levelling device. *a* is a spirit level box which is fitted with a lid or cover provided with a mirror *b*. *c* is the fore-sight in the form of an arm hinged to the box lid. The lid and mirror *b*, and the fore-sight *c*, are shown folded down on to the box lid. Fig. 3 shows the spirit level box

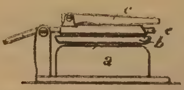
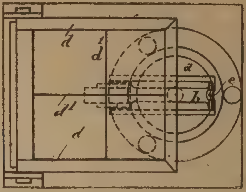


Fig. 1.

Fig. 4.



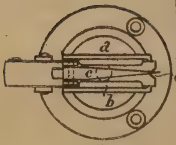
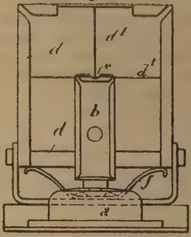


Fig. 2.

Fig. 5.



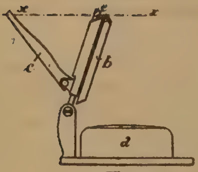


Fig. 3.

a with the lid and mirror *b* and the fore-sight *c* turned up into the position of use.

On sighting on a level with the eyes of the operator (as indicated by the line *x*—*x* in fig. 3) though the back-sight notch *e* and the fore-sight *c*, the camera is levelled at the same time by observing the reflection of the air bubble in the mirror. This form of my improved device is more especially designed for use for finding the image and levelling the camera in taking photographs on a level with the eyes of the operator.

In taking photographs above the level of the eyes of the operator the mirror is set to a correspondingly smaller angle so as to allow of observing the reflection of the air bubble in the mirror. In such a case the foresight *c* is not used.

Fig. 4 shows a modified form of my improved finder and levelling device with the parts folded down on to the spirit level box. *a* is the spirit level box fitted with a hinged lid and mirror *b*, and provided with a finder which consists of a frame *d* carrying webs or crossed threads d^1 in substitution for the fore-sight *c* of the device shown in figs. 1, 2, 3. *e* is the back sight notch. The lid and mirror *b* can be adjusted to any desired angle to the surface of the spirit level. This form of device may be employed with or without a concave lens.

Fig. 5 is an end elevation of the device with the parts turned up into position for use. *a* is the spirit level box. *b* is the mirror carried by or formed on the lid, and *d* is the frame carrying the webs or crossed threads. This frame is mounted on a flat spring *f*, and its pivot is situated in front of the spirit level, and the arrangement is such that when the camera is in a horizontal position at the level of the operator's eyes, and the mirror, consequently, at the maximum angle to the spirit level, the back sight notch *e* in the top of the lid or mirror is situated in a line with the point of intersection of the webs or crossing threads.

IMPROVEMENTS IN FLASH-LIGHT APPARATUS FOR USE IN PHOTOGRAPHY.

[Schmidt's Patent No. 14,700 of 1900.]

An improved flashlight arrangement for use in taking photographs, having the advantage that it allows of placing the person or object to be photographed in the correct light more easily and accurately, that it effects a better graduation between light and shade, and, finally, that it does not disturb or alarm persons being photographed by too great and sudden differences of light.

In the accompanying drawings fig. 1 is a front view of the apparatus and fig. 2 a side view thereof, partly in section.

The device is so made that a shade or screen A, having a reflective surface turned towards the person or object to be photographed, is provided with incandescent lamps B at or near the border thereof which throw their light on to said shade or screen A, and are separated from the object to be photographed by means of other small shades or screens C, or by a common ring-shaped shade.

Two contacts D consisting of carbon or other conducting material are placed opposite each other in the centre of the shade or screen A. These contacts lie in a powerful electric circuit, which can also be conducted through the incandescent lamps B arranged all round the shade or screen, and are so arranged that they can be separated from each other at any desired moment by means of an electro-magnet and a strong interrupting spark of extremely great actinic effect thus passes from one contact to the other.

This contact apparatus is also separated from the object to be photographed by means of a small screen E in such a manner that it throws its light towards the screen A, and from there on to the object to be illuminated.

The arrangement is connected by wire F with a circuit changer or switch which is arranged in any known manner, so that, on the one hand, a current is passed through the incandescent lamps B arranged around the contact apparatus, of an intensity sufficiently great for their ordinary working, and, on the other hand, also momentarily allows a strong current to pass into the circuit of said lamps, and again out of it, and then, at the same time, or at the next moment, passes through the two contacts D, which are simultaneously separated from each other by means of an electro-magnet, and then the interrupting spark of actinic effect is produced.

In this manner the object to be photographed is exposed to three lights of various strengths, that is, firstly, to the light reflected by the shade or screen A of the incandescent lamps B supplied with their ordinary current. In this light the photographer is able to place the object to be photographed in the desired light, which he can do very easily and with the greatest accuracy by moving the apparatus, as the beams which later on have an actinic effect fall upon the object to be illuminated exactly in the same direction as those which only illuminate.

When the object has been thus placed in the correct position and light, a powerful current is passed through the incandescent lamps by means of the circuit changer. These lamps are overcharged, and, consequently, now throw a white light of actinic effect towards the screen A, which light, the objective now being open, exposes the photograph, which, at the following moment, is completed by the immediate separation of the contacts D and through the interrupting spark produced thereby. By the increasing effect of the light described the photograph receives very soft tones, etc., and by means of this method persons are not, as hitherto, alarmed at the moment of taking the photograph, through the sudden appearance of the flashlight.

Fig 1.

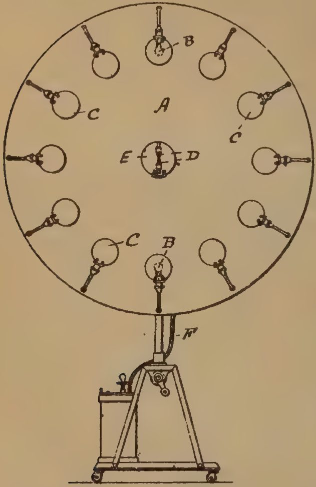
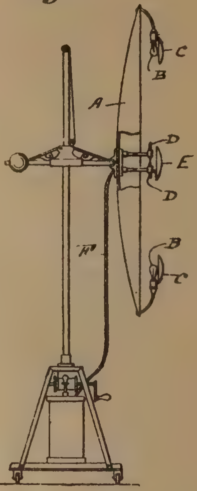


Fig 2



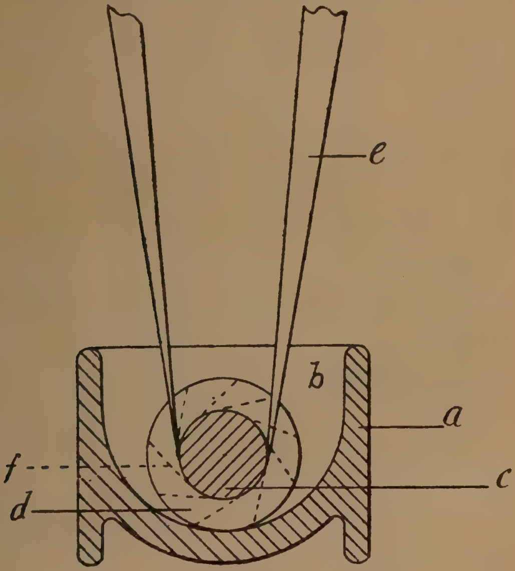
An electro-magnet can also be connected in any known manner with the circuit changer or switch, which magnet shortly before the powerful current is passed through the incandescent lamps and the contact apparatus, opens the shutter of the camera, and closes it immediately after the illumination.

The shades or screens C E which separate the light of the incandescent lamps and interrupting spark, respectively, from the object to be photographed, are transparent, so that they do not throw any undesirable shadow.

AN IMPROVED METHOD OF AND MEANS FOR TREATING EXPOSED PHOTOGRAPHIC FILMS.

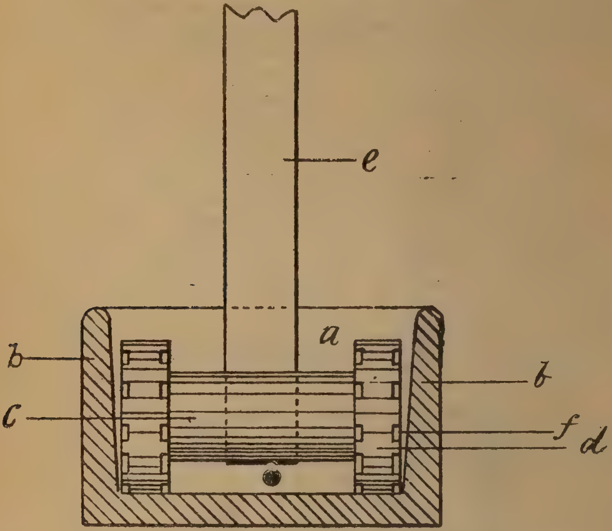
[Foster's Patent No. 14,530 of 1900.]

Relates to an improved method of and means for treating exposed photographic films, the object being to provide against cockling of the film, and other inconveniences at present connected with the development and other treatment of such sensitive surfaces.



— Fig.1. —

I attain these objects by the means illustrated in the accompanying drawing, in which fig. 1 is a cross section and fig. 2 a longitudinal section. I provide a semi-circular bottomed trough *a* of earthenware or other suitable material, and having upright ends *b*. Fitting loosely into this trough I provide a glass or other cylinder *c* having enlarged bobbin-like ends or flanges *d* which rest on the bottom of the trough and keep the intervening cylinder *c* somewhat thereabove. The cylinder *c* and ends *d* will hereinafter be referred to as the "bobbin," and should be made of some substance giving them appreciable weight. In use the bobbin is removed from the trough *a* and the latter supplied with a sufficient quantity of developing solution. The "bobbin" having been placed on a flat surface, one end of the film *e* is passed under the cylinder *c* with the coated side downwards.



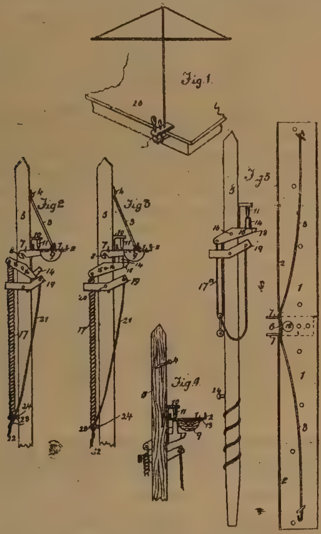
—Fig 2.—

The spool is then unrolled by the operator raising his hand on each side of the cylinder *c*, and by further raising his hands the operator can suspend the "bobbin" by the film *e* and lift it into the developing solution in the trough *a*, and develop the film by passing it to and fro under the cylinder by alternately raising and lowering his right and left hands. The friction between the cylinder *c* and the film *e* will cause the former to resolve more or less. In order to agitate the solution, the ends *d* of the bobbin can be fluted or otherwise formed, as at *f*. When development is completed, the film *e* and the bobbin can be lifted out of the solution and placed in a trough of water, and removed from thence to the fixing solution, the weight of the "bobbin" keeping the film from cockling or rolling up, besides admitting of it being quickly dried with the air all round it by suspending the film *e* by each end with the "bobbin" resting on it and keeping it taut.

IMPROVEMENTS IN FLASHLIGHT APPARATUS FOR PHOTOGRAPHIC AND SIMILAR PURPOSES.

[Fagan's Patent No. 15,118 of 1900.]

Relates to a cheap, simple, and reliable apparatus for producing flashlights for photographic and similar purposes, such as photographing interiors and making pictures at night. Fig. 1 is a perspective view of the apparatus mounted upon a table. Fig. 2 is a side elevation of an enlarged view of the upper portion of the apparatus, the hammer being cocked ready for use. Fig. 3 shows the position of the parts after firing the charge. Fig. 4 is a longitudinal section through the post and operating parts. Fig. 5 shows a side elevation of a modified form of the device, and a plan view of the pan; these views show the apparatus taken apart and ready for packing.



A trough or pan 1 is suspended from a post or suitable upright 5 by means of a wire bail or the like 3. The pan 1 is preferably long and narrow, and provided with flanges 2 to retain the flashlight powder or material. This material is spread along the pan in proper quantity and proportion for the purpose in view. The bail engages a pin or shoulder 4 upon the post 5. When the apparatus is packed up, the bail can be placed wholly within the pan, see fig 5, and, to hold the bail in place, its middle portion is passed under an inturned lip 6 of the pan. At the rear the pan is supported by two arms 7 which hook over pins 8 upon the post. The pan is preferably strengthened and stiffened by attaching to its bottom a strip 9 of wood or other suitable material.

Above the pan, on a suitable bracket, 10, is a stationary anvil or firing pin 11. In the bottom of the pan, below this anvil or firing pin, is a receptacle 12 in which may be placed a percussion cap of any ordinary and suitable make. This receptacle may be formed by a circular opening in the bottom of the pan, and a plate beneath the pan, said plate being, preferably, integral, with the arms 7 hooked to the post-pins.

The pan is made flexible, so that it may be depressed slightly in the middle to permit of the cap being placed in the receptacle 12 below the firing pin 11. Below this pin also is a hammer 14 carried by a pivoted lever 15 which is in the form of a yoke, the branches of which are pivoted at 16 on opposite sides of the post. To the rear end of the lever is connected a suitable spring. This is shown as a spiral spring 17, figs. 2, 3, 4, and as a rubber band 17 on fig. 5.

On the forward end of the hammer lever 15 is a detent 18, which is adapted to engage a trigger 19. The latter may be in the form of a hollow rectangle pivoted at 20 beneath the hammer. A cord 21 is provided to draw down the forward end of the trigger and release the hammer.

Another cord 22 attached to spring 17 is preferably provided for convenience in drawing the spring down, and, when the spring is tensioned, a loop 23 on its lower end engages a pin 24 on the post 5.

In use the operation is as follows:—The apparatus is fixed in position in any suitable manner. For instance, the post may be mounted on a clamp 25 which is securely attached to a table 26 or other support, or it may be inserted into a fixed socket. The pan is suspended from the post, and the flashlight powder is placed in an elongated heap upon the pan, and a cap is inserted in the receptacle 12 under the firing pin 11, care being taken to have some of the powder in the vicinity of the cap. The trigger is then engaged with the hammer, and the hammer is cocked, as shown in fig. 2. At the proper moment the cord 21 is pulled, releasing the hammer and permitting it to fly up under the influence of the spring. The blow drives the cap against the firing pin and explodes the cap, instantaneously igniting the flashlight powder.

IMPROVEMENTS IN APPARATUS FOR ASCERTAINING THE COLOUR AND DENSITY OF PHOTOGRAPHIC NEGATIVES

[Dawson's Patent No. 16,813 of 1900.]

Consists of an apparatus employing varying or adjustable apertures or graduations of density, and a screen, or screens, so arranged that light passing through a negative or light pervious object, illuminates the screen or screens, and can be measured or classified with a corresponding illumination obtained through one or other of the varying or adjustable apertures, or the like.

Fig. 1 is an elevation of the apparatus viewed from the side through which the operator looks. Fig. 2 is a plan looking at the top of same, and partly in section. Fig. 3 is a similar view to fig. 2, but showing a modification. Fig. 4 is a similar view to fig. 3, but showing another modification. Fig. 5 is a plan of one-half of one form of density disc employed. Fig. 6 is a plan of one-half of a modified form of a colour or density disc.

According to this invention the apparatus is, by preference, constructed in the form of a box 1 one side 2, of which may be omitted, if desired, so that the interior may be visible. The back of the box seen in fig. 2 consists partly of a double wall 3, which, if the box is made of thin wood or mill board or similar material, may be lined on the interior faces with velvet cloth, or the like, and by reason of its construction will have a slight spring so as to form a species of clip into which the negative or the like B can be inserted. This double wall portion has apertures 4, 4 through same, but the remainder of the back is solid, and has a single aperture 5. On the inside of the box, and secured to the back, is a strip of semi-transparent material 6, such as frosted glass, forming a screen extending across the apertures 4, 5, but the apertures may be screened in other ways where necessary. Carried by the back, and also inside the box, is a disc 7 having a number of apertures therein, graduated in size, as seen in fig. 5, and in front of same, and also carried by the back may be a further disc 8, having apertures which are all of the same size, filled or covered with tinted materials (which may be glass) of known actinic values. Both these discs bear suitable numbers, which, when exhibited at the point A outside the box, indicate which aperture or tint is opposite the aperture 5. This numbering is visible on the disc 8 in fig. 1, as on the front of same, but on the disc 7 it is placed on the back, so as to be visible from that direction.

FIG. 1

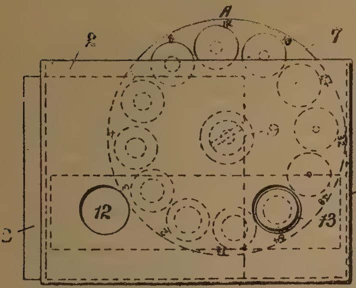
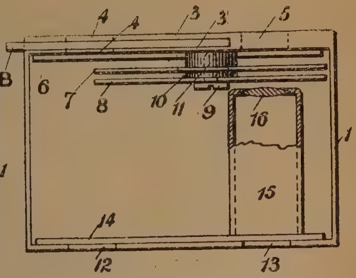


FIG. 2



Both discs may be attached by a screw 9 to a boss 10 secured to the back, a washer 11 separating the two, the arrangement enabling both to be turned independently when the finger is applied to the edge.

The front of the box contains two apertures 12. 13, inside of the front wall, being secured a screen consisting of a strip 14 of opaque material, such as frosted glass, so as to partly obscure the apertures, though other means may be employed for this purpose. Inside the box, and in line with the apertures, 13 and 5, is secured a tube 15 carrying a lens 16 though it may have simply an aperture, if desired.

It will be seen that the light from a given source illuminating the back of the box may be transmitted through the obscured apertures 4. 4 and a negative or the like placed between same on to the opaque screen covering the aperture 12 in front of the box, and thus be compared with the light transmitted through aperture 5, one or other of the apertures of discs 7 or 8 (or both, if employed) through the lens 16 (or aperture) on to the opaque screen 14 covering the aperture 13, the discs being adjusted until the amount of light upon the two screens corresponds, whereupon the negative, or the like, will be classed, according to the number or numbers exhibited at the point A It will be understood that

FIG. 3

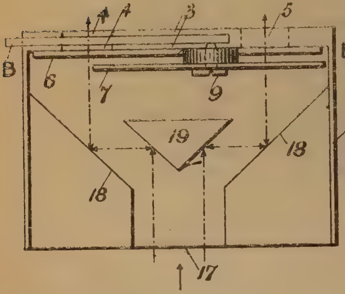
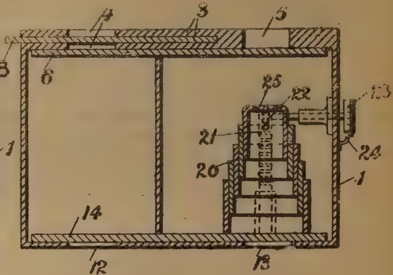


FIG. 4



the apertures in the disc 7 represent the relative densities of the negatives, or the like, to be classed, and that the disc 8 corrects for colour such disc being adjusted until the aperture obscured with the shade or colour corresponding with that of the negative, or the like, is brought in line with the lens and sight aperture, so that the actinic power of the two illuminations on the screened apertures 12 and 13 is equal.

FIG. 5

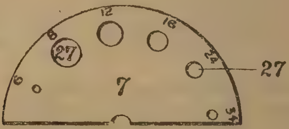
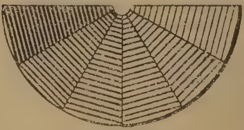


FIG. 6



Instead of two apertures 12 and 13 the arrangement shown in fig. 3 may be employed where a single aperture 17 is shown, the light being transmitted through apertures 4. 5 and disc 7 on to reflecting surfaces 18. 18 of the box, from whence they are reflected on to a prism 19, and directed by that to the aperture 17. the amount of light on each side of the prism, as viewed through the aperture 17 enabling the comparison to be made. In this arrangement the colour disc 8 is omitted, but may be used if desired.

Instead of varying apertures, I may use a uniform aperture, the distance of which from the screen is adjustable, as shown in fig 4, where a telescope tube 20 is employed, adjusted by a rack 21 and pinion 22, the latter being rotated by a spindle carrying a button 23 having a graduated scale on its periphery, which is read against a pointer 24 fixed on the side of the case.

The tube has an open aperture 25, and the illumination of the screen 14 through same, as seen through the aperture 13, follows the well-known law of inverse squares.

In place of the density disc 7, discs 27, fig. 6, suitably obscured different gradations may be employed. The instrument is adapted for ascertaining the light transmitting qualities of any substance pervious to light.

IMPROVEMENTS IN PHOTOGRAPHIC ACTINOMETERS.

[Watkins' Patent No. 19,331 of 1900.]

Fig. 1 is a front view, fig. 2 is a section drawn to an enlarged scale, and figs. 3 and 4 show the two graduated plates which can be turned to bring their graduations, which are logarithmic, to be visible under holes through the dial.

Fig.1.

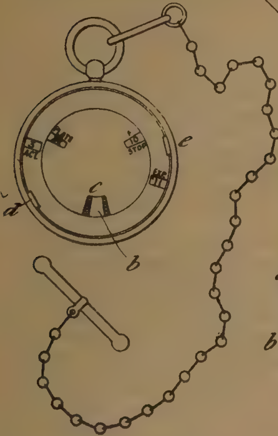


Fig.2.

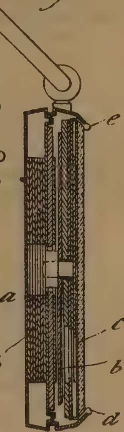


Fig.3.

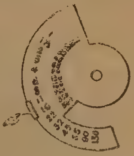
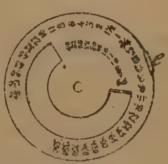


Fig.4.



The instrument is made in the form of a watch. Its back a, which can be turned round, has fixed in it a disc b of sensitised paper, successive parts of which can, by turning the back a, be made to present themselves at a hole c beside a patch of colour. Usually this is a certain dark colour, and the light value is reckoned by the time required for the piece of sensitised paper that is exposed to become darkened to the same shade. I prefer, however, to use as the patch of fixed colour the same colour as the sensitised paper itself, and note the time required for the sensitised paper to become perceptibly darkened, basing the light value on this observation, which occupies less time than when a dark patch is employed. There may, however, be placed, so as to be visible through the dial hole *c*, a dark patch, as well as the lighter patch, having a space between them through which the sensitised paper is seen. The two graduated plates shown by figs. 3 and 4 have projecting from their edges tongues *d* and *e*, by which they can be independently turned so as to present their respective numerals through holes of the dial marked, respectively, "Plate" and "Act," "F. Stop," and "Exp."

The two openings marked "Plate" and "F. Stop" are made through a fixed disc, but the other two openings, marked "Act" and "Exp.," are formed through a disc, which can be turned round by frictional turning pressure applied to the front glass.

Having ascertained the light value by the test at *c*, the operator moves the tongue *d* until the speed value of the plate used appears at the opening marked "Plate." He also turns the tongue *e* until the diaphragm or stop appears under F. He then turns the front glass until the light value appears through the opening marked "Act." The exposure that is to be given is then read in seconds or parts of seconds through the opening marked "Exp."

IMPROVEMENTS IN APPARATUS TO FACILITATE THE CUTTING OF PHOTOGRAPHIC AND OTHER PAPER INTO SPECIAL SHAPES.

[Bellas and King's Patent No. 11,668 of 1901.]

Relates to improvements in apparatus to facilitate the cutting of photographic and other paper into special shapes, the object of the invention being to provide a construction wherein the form-plate to which the paper is cut, is held firmly upon the paper, to clamp it against a base board or plate, a further object of the invention being to provide for releasing the paper after the cutting operation.

Fig. 1 is a perspective view showing the complete clamp, having its base formed by a table top. Fig. 2 is a central longitudinal section of the clamp.

The clamp is shown as mounted upon a base, which, in the present instance, is the top 5 of a table, said lamp including a fixed number 6 and a hinged or clamping member 8, the member 6 being secured to the base in any suitable manner, to hold it securely. The member 6 in the present instance is substantially triangular in form, and in the base thereof is formed a slot 7, the upper face of the member being cut away to form ears 9 and 10, through which are formed transversely-alining perforations to receive a pintle or pivot-pin 11. The second member or engaging member consists of a body-portion having a transversely-perforated ear 12 projecting from one end thereof, and adapted to lie between the ears 9 and 10 with its perforation in alinement with the perforations of said ears, to receive the pintle 11, so that the member 8 is hinged to the member 6 for movement in a vertical plane. At the opposite end of the member 8 from the ear 12 thereof are parallel arms 13, of which the body portion forms a connecting-web, and the inner faces of these arms and of the body portion are bevelled, as shown.

The form-plate used in this apparatus is provided with an opening of the shape to which the paper is to be cut, and this shape may, of course, be whatever desired. In the present instance there is shown a form-plate 15, in which is an elliptical opening 16, and this plate is disposed against the under side of the member 8, so that the opening liese between the clamping-arms of the member, and to hold the plate in position with respect to the member 8. spring-clips 17 are secured to the upper face of the plate, and in position to rest upon the bevelled faces, and thus prevent dropping of the plate from the member 8 when the latter is raised. These clips have sufficient frictional enlargement to prevent sliding of the plate longitudinally from the member 8. With this construction it will be seen that if a sheet of paper is properly placed upon the table or base, the member 8 may be swung downwardly to lie with the form-plate upon the paper, and, if the member 8 be held firmly in lowered position, it will hold the form-plate closely upon the paper, so that the paper may be cut with the usual form of cutting device run over the paper, and following the line of the opening in the plate.

Fig. 1

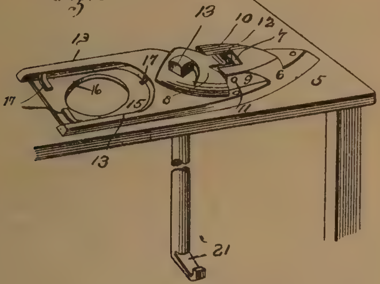
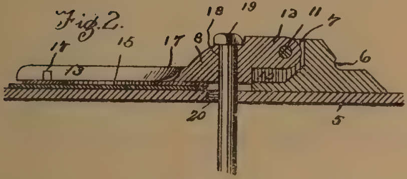


Fig. 2.



To raise and lower the holding member and hold it in lowered or operative position, the body portion of said member has an opening 18 therethrough, and passed through this opening is a headed rod or bar 19, the head of which rests upon the web, while the lower end of the rod extends through a slot 20 in the table 5, and has the lower end thereof turned laterally to form a pedal 21 to receive the foot of the operator. If, then, the lower end of this rod be swung to inclined position, the holding member will be raised pivotally, to permit of insertion of the paper thereunder, while, if the rod be swung in an opposite direction, the holding member will be swung downwardly, and into operative position, and may be held firmly against upward movement.

IMPROVEMENTS IN APPARATUS FOR DEVELOPING PHOTOGRAPHIC FILMS.

[Meek's Patent No. 19,396 of 1900.]

This invention is illustrated in the accompanying drawings:—Fig. 1 is an elevation of the apparatus. Fig. 2 is a plan. Fig. 3 is a side elevation.

A. is a base hollowed out for the purpose of holding the developing or other dish B. C. are standards shouldered at D. pulleys E. are loose on standards C. resting in their normal position on shoulders D. F. is a drum, with a portion H. cut out for the purpose of holding wedge G. attached to the axis of drum F. are hooks J. rubber bands K. are passed round pulleys E. and hooks J.

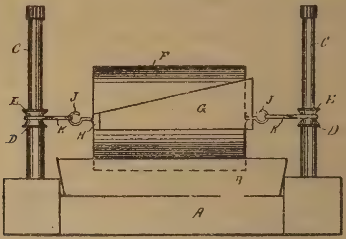


FIG. 1.

The apparatus is thus actuated, the drum F. is turned a sufficient number of times to allow the film to be operated upon, to be fully wound upon it, the wedge G is then removed, and one end of the film is turned over, inserted in the slot, and fixed in position by the wedge, then, by the torsion of the rubber bands, the film being held by the other end, can be drawn backwards and forwards as long as necessary through the developing and other fluids, to keep the film perfectly level on the surface of the drum, a small portion of the surface of the drum is shaved off.

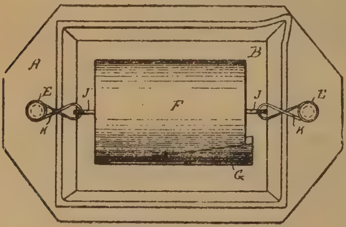


FIG. 2.

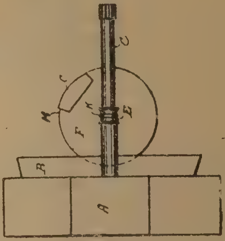


FIG. 3.

IMPROVEMENTS IN PANORAMIC PHOTOGRAPHIC CAMERAS.

[Houston's Patent No. 5140 of 1901.]

Relates to panoramic photographic cameras, and has for its object the provision of a folding panoramic camera adapted to use the rolls of sensitised film which are on the market, and generally known as film cartridges, and which are adapted to be inserted into cameras in daylight.

The principal object of the invention is the provision of a folding panoramic camera of novel construction, having a box-front containing a pivoted lens, said box-front closing the outer end of the camera bellows, which bellows is attached at its inner end to the camera case. Said bellows and box-front are adapted to be projected out of, and closed into, the central concave front compartment of the camera case, said box-front and bellows being supported upon an extensible supporting structure, and which structure is adapted to be extended out of, or folded into, the camera case.

Fig. 1.

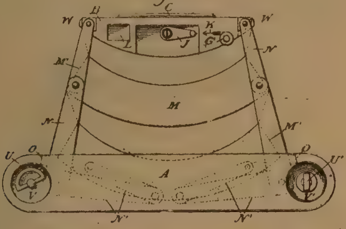
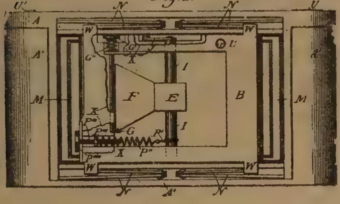


Fig. 2.



The invention contains many features of construction, and which, combined with the basic principal elements of the invention, make a very compact folding panoramic camera, and which is well adapted to be carried in the pocket of the user, and which camera can be adapted to make a picture as large as three by six inches in size, and include an angle of 75 degrees when constructed as specified, and thus my invention economises space, and makes possible the production of large-sized pictures, in proportion to the outer dimensions of the camera, and the camera still be of easy pocketable size and shape, the outer dimensions of which need not be to exceed one and one-half inches thick, four and one-quarter inches wide, and nine inches long.

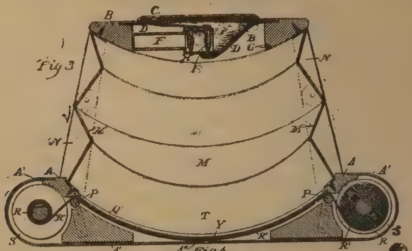
Fig. 1 in the drawings is a top-plan view of the camera, and shown three-fourths of the full size, and with the bellows and box-front projected forward.

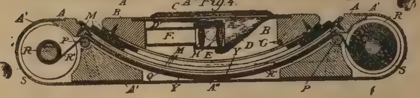
Fig. 2 in the drawings is a front view of the camera, and shown three-fourths of the full size, and with the box-front and lens, and bellows folded into the concave front compartment of the camera case, and with the flexible front of the camera not shown, so as to bring into view interior parts of the box-front of the camera.

Fig. 3 in the drawings is a horizontal central sectional view, taken lengthwise, of the camera, with the bellows extended.

Fig. 4 in the drawings is a horizontal central sectional view, taken lengthwise, of the camera, with the bellows and box-front and lens folded into the central concave front compartment of the camera.

At A is represented the camera case. At A¹ the removable back and ends of the camera case. At A¹¹ the observation aperture in the back of the camera case. At B the movable box-front of the camera. At C the outer opening protective front. At D the inner flexible front. At E the pivoted lens mount. At F the rearward extension of the pivoted lens mount. At G the catch to hold the extension of the lens mount when it is swung in opposition to the pressure of a spring. At G¹ the touch button. At G¹¹ the spring to hold the touch button up to place. At H the lens. At I the pivot upon which the lens mount swings. At J the set-lever. At L the finder. At L¹ the finder lens. At M the bellows. At M¹ the dotted lines showing the position of the bellows. At N the extensible supports for supporting the camera front. At N¹ the dotted lines showing the position of the extensible supports when they are folded into the camera case. At O the dotted lines showing stops which regulate the position of the extensible supports when they are extended. At P the rounded guides for the sensitised film. At Q is shown the lower one of the circularly-positioned stationary guides for the sensitised film. At Y is shown the circularly-positioned transparent support for the sensitised film, and which support can preferably be made of transparent celluloid, or may be omitted if the film for the camera is made sufficiently heavy to properly bridge over the space between the circularly-positioned guides for the film; but, when very thin light films are used, then the transparent support for the film may be necessary. At R the





spools. At R^1 the sensitised film. At S the outer compartments for holding the spools. At T the concave central front compartment. At U the thumb-piece of the reel centre. At U^1 the outer end of the spool centre. At V is shown a depression in the camera case which allows the outer end of the reel centre to lie below the general surface of the camera case, and the thumb-piece to fold into the said depression. At V^1 is also shown a depression in the camera case, which allows the spool centre to lie below the general surface of the camera case. At W are shown four extensions of the camera front, to which the outer ends of the extensible supports are connected. X points out the uneven lines by which are shown the cutting away of portions of the drawings, so as to bring in view the set-lever, the touch-button, and the catch for holding the extension of the lens mount, and the spring connected to the nut, through which nut a tension screw passes. At P^1 is shown a cord passed around the pivot post I, which cord is attached to a spring P^{11}, having a nut P^{111}, through which nut a tension screw P^{1111} passes, said tension screw having a thumb head P^{11111}, and as the aperture through which the nut passes is made square, and the nut square, it follows that, in turning the tension screw, the nut will not turn, but will be moved forward or backward, as the case may be, and the spring tension increased or decreased by the operator, to increase or decrease the speed of rotation of the pivot post and lens pivoted thereon.

In preparing the camera for use, the operator removes the back of the camera and inserts a spool of cartridge film into the spool side of the camera, then passes the end of the paper wrapper of the film forward and over the guide roller, and forward and behind the circularly-positioned guides and transparent support, then forward and over the opposite guide roller, and attaches the end of the paper wrapper to the reel spool, and by winding the reel the end of the wrapper of the sensitised film will be wound around the reel, then should be replaced the back of the camera, and the wrapper and film wound forward, until the first number on the back of the wrapper comes opposite to the observation aperture in the back of the camera.

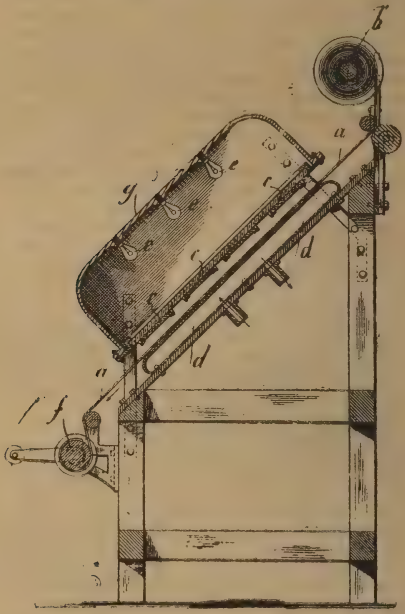
The camera is used as follows:— Project the box-front of the camera as shown in fig. 1, and set the set-lever to point to the arrow mark, and the catch will hold the lens mount rotated in opposition to the motor spring connected to the pivot post. Next open the protective-front, and, having pointed the camera to the view, and holding the camera level, then press the touch-button, which will release the catch, and liberate the lens mount and the lens to revolve by the power of the motor spring, and during the revolution of the lens upon its focal axis, the light from the view will be made; next close the protective-front, and then fold the box-front and the bellows into the camera case.

IMPROVEMENTS IN PHOTOGRAPHIC COPYING PRESSES.

[Gerlach's Patent No. 2997 of 1901.]

Photographic copying presses, in which sensitised paper is unwound from a reel, and, being exposed to the light of incandescent lamps, is pressed against the negative by means of a vacuum, or rarefaction, are already in use. Because a sucking action is utilised in these apparatus, it is necessary to employ mechanical means to press a proportionately heavy frame against the sensitised paper. These apparatus have also the drawback that the frame must be removed from the negative by some mechanical means, such as springs, so that the sensitised paper could not be easily and certainly pressed against the negative. In addition to this, when suction is used, the sensitised paper becomes fixed to the negative, so that it can only be removed from the same by exercising force. The consequence of so removing the paper from the negative is that, either the negative itself, or the gummed strips used for securing the same, are torn, or the prepared surface, or the paper itself, is injured.

In order to overcome these drawbacks, I use a pneumatic cushion to press the sensitised paper against the negative, so that the heavy frame necessary with apparatus working with suction is dispensed with. On allowing the air to escape from the cushion, the latter falls of itself away from the negative, so that the paper can pass freely beneath the same.



A very essential improvement is, that, I arrange the printing table at an angle to the horizontal plane. Whereas, with the constructions at present in use, the paper, on being moved beneath the negative, frequently strikes or bears against the latter, thus injuring either of the prepared surfaces; the paper can, when the table is arranged at an angle, be moved from the upper roller, over the pneumatic cushion, and wound on the lower roller, without danger of its coming into contact with the negative. With horizontal tables, the drawback of the sensitised paper bearing against the negatives is especially noticeable when the negatives, as is usually the case, are situated at different levels. All these drawbacks are avoided in my present invention, which, by the provision of a pneumatic cushion, and by the inclination of the table, produces good prints, even when the negatives are arranged at different levels. In this respect the ability to easily draw off the sensitised paper, in consequence of the inclination of the table, is a very important factor.

The sensitised paper *a* passes from the reel *b*, between the negatives *c* and the cushion *d*, to the reel *f*. The table, which is constructed of wood or any other suitable material, is inclined, as shown in the drawing.

If air is pumped into the cushion *d*, which is provided underneath and parallel to the negatives *c*, the paper *a* will be pressed against the negatives. At the same time, electric lamps (for example, incandescent lamps), which are provided underneath the hood *g*, are automatically caused to burn.

After the plates have been sufficiently exposed, the lamps are switched off, and the air is allowed to escape from the cushion *d*. When deflated, the cushion *d* falls away from the negative, so that the paper *g* can be passed between the negatives and the cushion, and wound on the drum *f*, without danger to its being injured.

A PROCESS OF DIRECT PHOTO ZINCOGRAPHY.

[Vandyke's Patent No. 6307 of 1901.]

Is a process of obtaining an image in transfer ink on a metal plate or other printing surface, direct from a black and white original without the intervention of a photographic negative. It consists of the following operations:—1, coating the plate; 2, exposure to light; 3, development of a negative image; 4, inking the plate; 5, development of a positive image. After the last operation the plate is similar in all respects to one produced by the ordinary method of photo-zincography, and can be printed from in the usual manner.

Any subject drawn or printed in black on paper or tracing cloth can be dealt with. The original must be on the scale of reproduction. The operations are:—

(1) Coating the plate:—Thin zinc plates (preferably grained in the usual manner) are coated with a sensitising solution consisting of a bichromatised colloid substance, of which the following is a good formula:—

Fish glue	1 ounce.
Soft gelatine	60 grains.
Bichromate of ammonia	45 grains.
Water	12 ounces.

This is best done by flowing the solution over the plate while damp, and placing it on a whirler to spread the coating evenly; it is then hung in a drying box, and dried by heat in the dark.

(2) Exposure:—The subject for reproduction is laid on the printing frame face upwards, and the plate laid in position upon it with the sensitive surface in contact with the face of the subject. This must be done in a weak or yellow light. Perfect contact is essential. It is then exposed to light. The exposure varies greatly, according to the light and the thickness of the original. For a tracing, half a minute's strong sun may be sufficient, and a drawing on thick paper may take six or seven minutes, or more.

(3) Development of a negative image:—The action of light through the subject hardens the bichromatised glue and renders it insoluble in cold

water. It is, therefore, possible, by the action of water, to develop away the unaltered glue which has been protected from light by the lines of the drawing. Light rubbing with cotton wool should be resorted to, to thoroughly clear the lines. When fully developed, the lines of the drawing stand out in clean zinc, sharp and distinct. To facilitate development the plate should be stained with an aniline dye, which enables the operation to be watched while in progress. It is then washed and dried. Any defect in the ground caused by the accidental removal of the glue, or through stains in the original, can be remedied at this stage by painting them over with gum, which will prevent them from appearing in the finished plate. A negative of the original has been thus obtained which it is necessary to convert into a positive.

(4) Inking the plate:—The ink used for inking the plate is ordinary lithographic writing ink and powdered bitumen, melted together in equal parts; or, transfer ink, mixed with Burgundy pitch, or other substance that will adhere firmly to the plate, may be used. It is thinned with turpentine and well rubbed into the lines of the drawing with a pad, and a thin coat left all over the plate. It can also be applied with a roller. The lines are now covered with ink, and the background still remains covered with hardened glue, having a coating of ink over it.

(5) Development of positive image.—The next operation is to get rid of this glue, leaving the ink-covered lines intact, and this is effected by immersing the plate in very dilute hydrochloric acid, which softens the glue, so that it can be easily removed with a sponge or piece of flannel. The ink-covered lines are not affected in an way. It is necessary to remove the glue background very thoroughly. The plate should be rubbed over with carbonate of magnesia, and dried, and is then ready for printing, and is in every way similar to one produced by the ordinary method of photo-zincography.

IMPROVEMENTS IN OPAQUE BACKINGS OR COVERINGS FOR PHOTOGRAPHIC FILMS.

[Evans' Patent No. 9120 of 1901.]

The invention consists in a simple, economic, and effective means of protecting or insulating the sensitised film with a sheet or strip of printed opaque material, without necessitating the use of collodion or varnish, or any other impermeable substance, while avoiding the roughness which results from the employment of the opaque sheet or strip.

For this purpose a mucilage, and, by preference, gelatine, is exclusively employed, such as that which photographic emulsions are obtained with bromide of silver, that serves to sensitise the films.

In carrying the invention into effect, a thin layer of gelatine, in solution, is spread out upon a polished surface, which may be continuous, such as oil-cloth, or of definite dimensions, such as a piece of glass, and this layer is allowed to coagulate or dry. Taking the sheet or strip of printed opaque material, it is applied with the printed matter underneath upon the layer obtained, and with the application of water a perfect contact is obtained. The whole is rapidly dried, and, after drying, it suffices to take up the corner of the opaque sheet or strip for peeling it from the polished surface, by which the layer of dried gelatine or mucilage is also brought off adhering closely to the opaque material. By such means the more or less wrinkled surface of the opaque material is rendered into a surface perfectly smooth, glazed, or enamelled, and the coating obtained is of absolute regularity, and constitutes a cover or insulator of regular thickness.

The entire length of the opaque material may be submitted to this operation, or only such part thereof as would, after being rolled up, be in contact with the sensitised film.

The gelatine may be employed alone, or other substances may be embodied with it, so that its properties may be modified; but its permeability to water is required.

IMPROVED APPARATUS FOR AUTOMATICALLY RELEASING THE SHUTTER OF A PHOTOGRAPHIC CAMERA.

[Weiss' Patent No. 8909 of 1901.]

The device consists of a disc revolved by clockwork and placed on the apparatus, which disc is provided with adjustable hands. which, in the predetermined space of time, operate the releasing key or button.

Figs. 1 and 2 are views of the device in combination with a releasing key; while fig. 3 shows the apparatus in connection with a releasing pin. On one side of the camera *a* is arranged a disc *b*, which is provided with a scale, and which can be set in rotation in the direction of the arrow by means of a clock mechanism. On the disc are placed two adjustable hands *d* and *f* (fig. 2), which can be fixed in the desired position by means of set screws g and g^1.

If the apparatus is intended to release a simple instantaneous shutter, where it is only necessary to press the key *o* once, it suffices to put the hand *f* at a certain point of the scale (for instance, as is illustrated in fig. 1), and the photographer, if he wishes to be photographed, has so much time to pose in his place until the hand *f* has completed the course *z* to the key. As the hand *f* is adjustable on the disc *b*, and the latter itself, when the clock mechanism is set going by the photographer, turns very slowly in the direction of the arrow, the photographer is able to pose at a place some distance from the lens, as the release does not take place before the hand *f* has pressed down the key *o*.

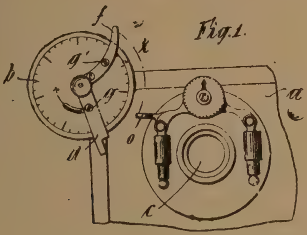


Fig. 1.

With time shutters the operation of releasing or exposing the lens is exactly the same as with instantaneous shutters, only, when the exposure is ended, the key *o* must be once more pressed down, which takes place by means of the hand *d* (fig. 2) at the moment that the latter completes the course *w*. The difference from *w* to *z* is the duration of the exposure.

The difference between this and the instantaneous shutter only consists in the hand *f*, owing to its curved shape, running on when it has pressed the key *o*, until the hand *d* also presses the key, thereby operating the shutter.

In apparatuses when the mechanism is not operated by a key, but by a stud o^1 (fig. 3), which is pressed into the apparatus, the revoluble disc *b*, for the instantaneous shutter, is of the form shown in fig. 3. For time shutters the bolt must be pressed into the apparatus for a longer time, according to the duration of the exposure; and in order to attain this there are arranged on the disc *b* segments *i*, which can be moved and firmly fixed, and which, when the disc moves in the direction of the arrow (fig. 3), act so that the cam *h* is prolonged, and the bolt o^1 consequently remains pressed in the apparatus until the photograph is taken.

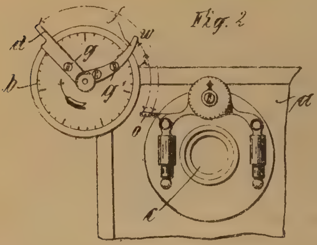


Fig. 2

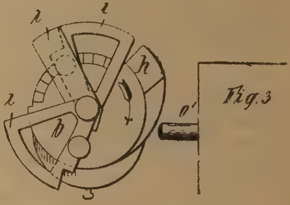


Fig. 3

IMPROVEMENTS RELATING TO STEREOSCOPES, AND IN BOOKS AND MOUNTS FOR STEREOSCOPIC VIEWS.

[Jones' Patent No. 10,428 of 1901.]

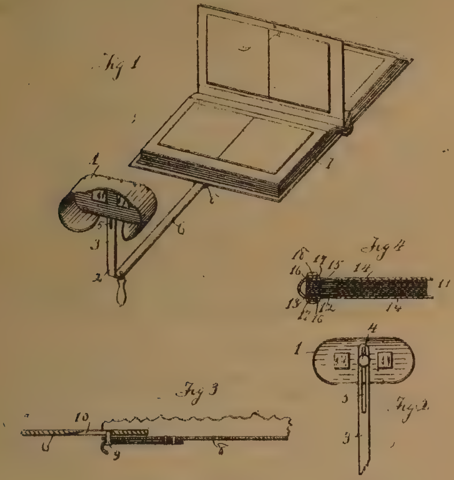
Relates to stereoscopes, and has for its object the providing a novel combination, comprising a stereoscope and a book of stereoscopic views or pictures, in which a series of such views may be consecutively exhibited within the focus of the lenses. In the accompanying drawings,

Fig. 1 represents an isometric view of a combined stereoscope and book of stereoscopic views, constructed and arranged according to my invention. Fig. 2 represents a front view of the head of a stereoscope showing the shaft adjustable thereon. Fig. 3 represents a detail sectional view of a portion of the shaft, and keeper for retaining the book thereon. Fig. 4 represents a cross section of the book, showing the flexible construction of the cover and leaves.

1 represents the hood of a stereoscope, provided with the usual lenses. Upon the front of the hood the vertical portion 3 of a shaft 2 is adjustably mounted by means of a set screw 4, passing through a slot 5 in said shaft. Said shaft comprises also a horizontal portion 6 upon which is slidingly mounted a book of stereoscopic views 7, by means of a keeper 8 arranged to slide longitudinally upon said horizontal portion 6 of the shaft. To prevent said book from becoming accidentally

dismounted from said shaft, there is provided upon said keeper a spring actuated stop 9, arranged to engage a recess 10 in said shaft, as shown in fig. 3.

As shown in fig. 4, to give the necessary flexibility to the leaves and cover of the book, the leaves are formed of cards 11 connected by a flexible portion 12 with a thickened heel portion 13, and the covers are formed of a stiffened board 14 connected by the flexible portion 15 with a heel portion 16, and the heels are clamped together between bars 17 by binding or clamping screws 18.



In use and operation the book is mounted upon the shaft, and the hood is adjusted to the proper height, to correspond with the views mounted upon the leaves, and the views brought within the focus of the lenses by sliding the book upon the shaft. Then, by turning the leaves, the views will be brought successively before the lenses. And thus may be exhibited with facility any consecutive series of events, or consecutive scenes of history or of travel.

DEVICE FOR ROLLING UP FILMS IN PHOTOGRAPHIC APPARATUS, WITH MEANS FOR LOCKING AGAINST ROTATION IN THE DIRECTION FOR UNWINDING.

[Browne's Patent No. 10,610 of 1901.]

Relates to the devices for winding up the film in photographic cameras, and has for its object a mechanism which is to serve for the purpose of preventing rotation in the direction for unwinding. It differs from the arrangements hitherto proposed for the same purpose, in that the parts serving solely for the purpose of locking, as ratchet wheels and pawls, or the like are dispensed with; hence no room has to be provided for the same. This invention is, therefore, particularly adapted for film cameras of the class in which there is no room for placing parts specially intended for locking, for instance, such as have very thin wall or sides, say those of metal.

In the drawings is shown a mechanism with said locking appliance, fig. 1, being a vertical section, fig. 2, a plan, showing it applied to a camera fig. 3, being an underneath plan, and figs. 4 and 5, details.

The device for turning the winding roller shown by dotted lines in fig. 1, consists of a rotating spindle *b* turning in an elastic holder *a*; this has below the catch *c* engaging with the roller, and above the handle or head, *d*.

Fig: 1

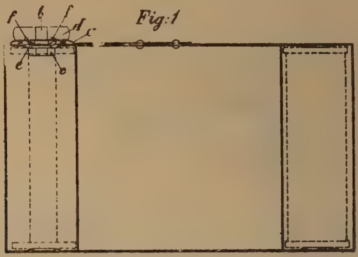


Fig: 2

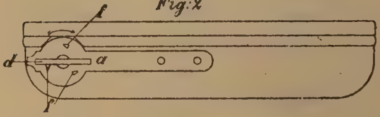


Fig: 3

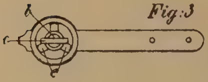


Fig: 4

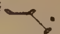
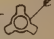


Fig: 5



A spring *e*, is provided on the spindle *b*, acting from below upon the holder *a*, see also figs. 4 and 5. This spring pulls the head *d* against the upper part of the holder *a*. From the upper surface of the holder rise a suitable number of cams or projections *f*. In the drawings three are shown. These present inclines rising in the direction of the arrow in the drawings, and to wind up the film the spindle *b* has to be turned in the same direction. In the opposite direction each cam or projection forms a stop. By reason of this arrangement the handle, or head *d*, slides over the projections, when turned in the direction for winding the film up, but is prevented from moving in the opposite direction, so that unwinding of the film from the winding-up roller is prevented.

AN IMPROVEMENT IN PHOTOGRAPHIC FILM ROLLS.

[Haddow and Turner's Patent No. 11,622 of 1901.]

The films for photographic cameras are often rolled upon a reel along with a strip of black paper, or the like, which prevents access of light to the sensitive film, as it is unrolled. This black strip has usually stencilled on it numbers and marks which can be seen through the window of the camera, these indicating the extent of the film that has been exposed, and the points of separation of the successive pictures. It is found that the black material and the stencil marks thereon produce visible effects on the film which are objectionable.

The invention relates to means of obviating this objection.

For this purpose, along with the film and the black paper, the inventors roll up a strip of white paper, of such character that it has no effect on the film, which, as it comes next the film, protects it from any influence on the black paper. On the white paper they make the required numbers and marks that are to be seen through the camera window, but they do not make these marks in any colour which might effect the film, but by perforations arranged in the forms of the letters, numerals, or other desired marks. They also, in the same manner, mark, by perforations of the white paper, the points where the film has to be cut for the separate pictures.

IMPROVEMENTS IN ORNAMENTAL MOUNTS FOR PHOTOGRAPHS.

[Macleod's Patent No. 11,154 of 1901.]

Consists essentially of ornamental corner pieces, which can be fitted on the corners of loose photographs and the like, and inserted in albums, etc., to receive the photographs, permitting the handling of the photographs without it being necessary to touch the surface thereof, and rendering the insertion in albums and other books easy, without the necessity of providing slits to receive the photographs as usual, the whole adding greatly to the appearance of the photographs or pictures.

Of the drawings, fig. 1 is a view showing the application of the invention to a loose photograph. Fig. 2 is a view showing the mode of application to a page of a photographic album. Fig. 3 is a view of a blank for a corner piece. Fig. 4 shows another suitable form of corner piece.

The blank (fig. 3), which is a blank of one of the corner pieces, shown in use in fig. 1, consists of a base *a* and side flaps a^1 and a^2, which are adapted to be turned over on to the base *a*, so as to form a corner piece, within which a corner of a photograph can be inserted, as shown in fig. 1, so that the base *a* is below the photograph, and the flaps a^1, a^2 over it. The under surfaces of the flaps a^1 a^2, that is, the surfaces uppermost in fig. 3 are covered with adhesive, and it will, therefore, be seen that, when fitted to a photograph and caused to adhere to it, these corner pieces provide for handling the photographs without it being necessary to touch its face, and the need for special mounts to some extent is obviated.

These corner pieces are coloured and ornamented on the surfaces which show, and the result is therefore an ornament to the photograph, as well as a useful attachment thereto.

In fig. 1 two of these corner pieces are shown, as, ordinarily, these will be sufficient; but, of course, all the corners may have corner pieces.

When applied to a photographic album, according to the second part of the invention, the corner pieces are gummed or otherwise attached at their undersides, to the pages, in the proper positions, to receive a photograph. The need for slits or the like is therefore obviated.

In this case the flaps a^1 a^2 are attached to the page, while the base a will be uppermost, and the inner surfaces will not be covered with adhesive. Consequently, photographs can be inserted in, or removed from, the album, as desired.

Fig. 1.

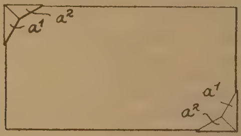


Fig. 2.

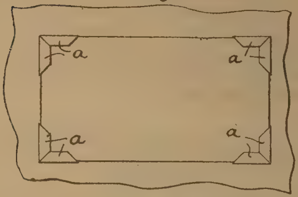


Fig. 3.

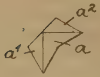
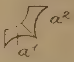


Fig 4.



In figs. 1 and 2 two different designs for the corner pieces, while fig. 4 shows another very effective one; but it will, of course, be evident that the shapes and colours and style of ornamentation can be varied almost indefinitely, and different corner pieces can be used for one photograph, while an album will preferably have its pages variously treated in this matter.

For loose photographs the corner pieces will be sold in assorted packets, and the same can be done for ordinary albums, the corner pieces having the proper surfaces of the flaps a^1 a^2 covered with adhesive.

PROCESS FOR REPRODUCING PRINTED COPIES OF DRAWINGS, OR THE LIKE, FROM PHOTOGRAPHIC COPIES OF THE SAME.

[Tellkampf's Patent No. 8,645 of 1901.]

Relates to a process for reproducing printed copies of drawings, or the like, from photographic copies of the same by transferring the photographic copies upon stone, zinc-, aluminium-, or the like plates.

In order to carry the process into effect, a heliographic chrome copy of the drawing, or the like, is produced. This chrome copy is made upon a sized or albumenised paper, and is developed in water, so that the chrome-albumen, or the like coating is washed away in those parts where the lines of the drawing were in the original, while, on the other parts of the paper the chrome-albumen coating remains. Next, the whole paper is coated with a printing ink suitable for printing upon stone, zinc, aluminium, or the like, plates, whereupon the chrome-albumen, or the like, coating, is dissolved by means of diluted acids, so that the printing ink is dissolved from the paper in all parts in which no lines were in the original drawing. Thus it is attained that only the lines stay on the paper. The copy so produced is now transferred in the well-known manner to a stone, zinc, aluminium, or the like, plate, and reprinted from the same.

As printing inks for coating the paper, the well-known lithographic or autographic inks may be used, yet mixtures of turpentine-oil, black japan, solutions in asphalt in turpentine-oil and alcohol (so-called alcoholic iron varnishes), and fats, consistent oils or waxes dissolved in the mixture have proved to be most suitable for the purpose. All mixtures of turpentine-oil, black japan, consistent oils, or waxes dissolved in the mixture, and alcoholic solutions of shellac or other resins, in quantities not greater than to mix well and thoroughly with the other mixture, have proved fit for this purpose. Advantageously, a sufficient quantity of colouring matter is added to the mixture, in order to facilitate corrections of the drawing on the stone or metal plate.

The following are the mixtures most advantageously used:—

1.	Turpentine-oil	20 parts.
	Black japan	40 parts.
	Alcoholic iron-varnish	10 parts.
	Tallow	10 parts.
	Soot	5 parts.
2.	Black japan	20 parts.
	Turpentine-oil	40 parts.
	Yellow wax	10 parts.
	Lamp black	5 parts.
	A shellac solution containing 8 per cent. shellac	10 parts.

The fatty substances or waxes are advantageously smelted, and then dissolved in turpentine-oil, and added to the mixture.

IMPROVEMENTS IN PHOTOGRAPHIC FABRICS AND PROCESS FOR PREPARING PHOTOGRAPHIC FABRICS.

[Page's Patent No 10,524 of 1901.]

The process consists in part in the use of certain substances extracted from the white algea chondrus crispus, with certain other agents in common use in photography.

The novel features of the invention will be best understood by describing one preferred way of utilising the process, and of manufacturing the new fabric. If desired to make sixteen litres of solution for treating the fabric, it is accomplished by the following procedure:—Place one hundred and twenty grammes of dried Irish moss, chondrus crispus, in thirty-two litres of cool water, and gradually heat the water until it boils, which, ordinarily, takes some fifteen or twenty minutes by the procedure employed. Then stop the application of heat, and let the solution stand about five minutes. Then, into a sixteen-litre vessel, in which one hundred and sixty grammes of citric acid have been placed, draw off, through a fine sieve or coarse filter, about sixteen litres of the algea solution or extract, taking it preferably from near the bottom of the vessel, and mix this with one hundred and sixty grammes of citric acid, and add two hundred and forty grammes of chloride of ammonium. The remaining portion of the algea extract is discarded, as it is too thick.

Silk is treated with the solution by immersing it for a few minutes in a flat sheet, so as to expose all its surfaces evenly to the solution. Then the silk is dried, and it is ready for sensitising by immersing it in any suitable sensitising bath. Upon again drying the fabric, it is ready to be photographically printed from a negative in the usual manner. The photographs so produced on the silk are admirably adapted for colouring. The fabric does not show the presence of any film resembling a gelatine or albumen film: on the contrary, the white portions of the silk in the finished picture look precisely as the silk looked before being treated.

Tapestries, particularly thick tapestries, may be wet on one side only in the solution by being laid face down in the shallow tray containing the solution. Considerable latitude in proportions are permissible in carrying out the invention, but it will be found that the proportions stated give the best result.

Without attempting to set forth what other algæ are the known equivalents of chondrus crispus, or yield the same or similar extracts, chondrus crispus is named as being the only one that has been found to be entirely satisfactory for the purpose.

RECENT NOVELTIES IN APPARATUS, &c.

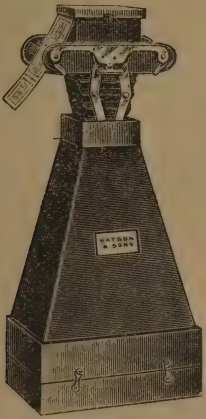
By the Editor.

[*These notices are confined as far as possible to apparatus introduced since the publication of the last Almanac. In all cases the various articles have come under our personal examination, a rule from which we allow no departure.*]

ENLARGERS FOR KODAK NEGATIVES.

Manufactured and sold by W. Watson and Sons, 313, High Holborn, W.C.

This is a simple instrument for enabling Kodak film negatives to be enlarged on paper or glass. It is constructed for use in conjunction with the Kodak itself, so that the same lens which takes the negative also makes the enlargement. The system in practical use entails no focussing or adjustment; "the Kodak is simply attached to it; the negative and bromide paper put into position, and an exposure given, varying from 15 seconds in summer to 4 or 5 minutes in winter, according to the negative." The Kodak is removed from the outer case (the shutter being first opened and the diaphragm set to the desired aperture), and placed, lens downwards, in the narrow end of the enlarger. The projections must fit into apertures provided for them, and the camera set square. The film negative to be enlarged must then be placed between the two glasses of a carrier provided for the purpose, the film side being placed inwards. The photographer is now directed to fasten

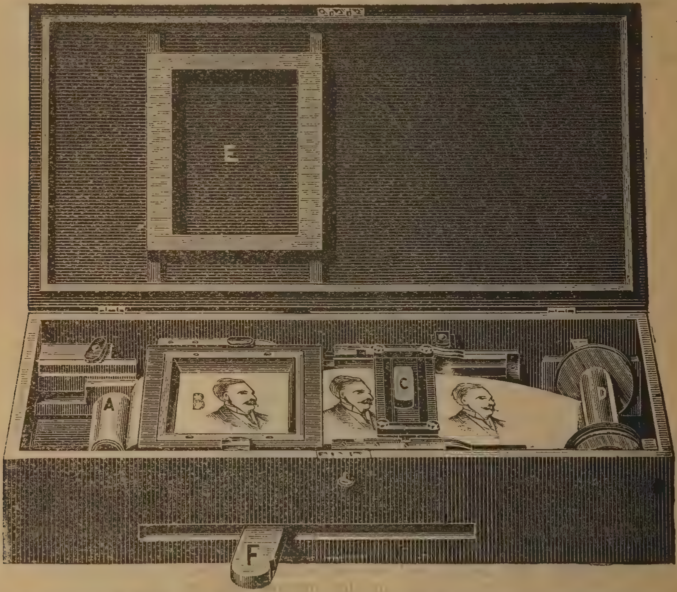


the elastics to keep the negative in position, then to push the frame down into the body of the Kodak as far as the rebate in the frame, and next to close the shutter of the enlarger, and carry the whole apparatus into the dark room. "Unfasten the hooks, take off the end, and place between the glass and the piece of cardboard a sheet of bromide paper, sensitive side up, i.e., towards the glass. Replace the end on the cone, by pushing the body of the cone down into it, not vice versa, or the glass or bromide paper may become displaced. Fasten the hooks securely, and carry the enlarger into the daylight. Draw the shutter, and make the exposure by pointing the negative towards the sky, being careful that neither the direct rays of the sun nor the shadow of any overhanging near obstacle fall across the negative."

THE "SOHO" BROMIDE PRINTING MACHINE.

Manufactured and sold by Marion and Co., Soho-square, London, W.C.

The measurements of this machine are 26×13×6 inches. In use the roll of unexposed paper is placed in position at A, the end (plain paper) passed under the negative-holder, B, which is easily raised for the purpose, then between a grip, C, and finally attached to the receiving-spool, D. With a left to right movement of the lever, F, the paper is properly straightened under the negative, and, this being accomplished, F is pushed to the extreme left, and all is ready for exposing. The exposures having been made, the paper must be changed, and here we quote from



the succinct instructions: Grasp the lever, F, and press it to the right firmly and quickly as far as it will go, then bring it back again to its original position. What takes place by this movement is, as soon as the lever is moved, the negative-holder, B, is raised, leaving the paper free. Grip, C, moves along, pulling the paper with it, which at the same time is rolled up on the spool, D. On the return movement, spool D does not move; the grip, C, releases the paper, and as soon as the lever has reached its first position the holder, B, comes down again into contact. The frame, E, is on springs, which keeps the whole in position. The exposure is, of course, made to an artificial light.

THE DREADNOUGHT ACETYLENE GENERATOR.

Manufactured and sold by W. Tylar, 41, High-street, Aston, Birmingham.

WEIGHING only 6 lb., the height of the dreadnought is 13¾ inches, the diameter at the base being 7¼ inches, and at top 5½ inches. It takes a pound of carbide, and is claimed to illuminate a 9 ft. circle for about two hours with a double jet, the candle-power being estimated at about 250. The chief parts of the instrument are shown in the first three illustrations. Fig. 1 shows the outer case, or generator, a double cylinder containing water used for the generation of the gas; the lower tap is used to gauge the height of the water in the bottom portion, which is filled until the water flows from the tap. Fig, 2 shows the carbide holder. A rod passes through its centre, which is attached at its lower end to a valve, and is actuated by pressure on a spring at the top. This rests, when in use, upon the edges of the top water compartment. It is filled with granulated carbide, by removing the screw cap shown on the left hand side of the spring. Fig. 3 is the gas bell, which is placed in the water in the top compartment, and rises and falls therein as the gas is made and consumed. As long as the gas bell is full of gas, no pressure can be exercised on the spring actuating the valve in the carbide holder, but as soon as gas is burnt, and the bell, which is weighted, sinks

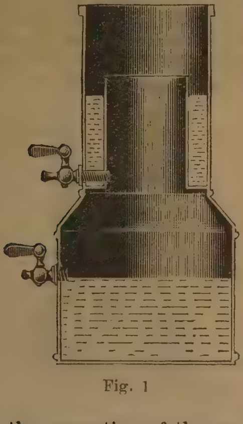


Fig. 1

down—touching on the top of the valve rod—more carbide is dropped in the water, gas is made, the bell rises, and the valve is safely shut until the next touch of the bell. Fig. 4 shows the generator charged ready for use. We append directions for charging and using the Dreadnought, which, as the result of our inspection of it, struck us as neatly devised, simple in action, and well calculated to prove a useful means of obtaining a supply of acetylene illuminant without great trouble: Lift out the gas bell, remove the carbide holder, and fill with granulated carbide through the hole covered by the screw cap. Fill water in the base of generator, as shown by the dotted lines, until it runs out of lower tap. Fill water in the top compartment to within one inch of the top. Hold the carbide holder over a sheet of paper, and touch the top to see if the valve works freely, as will be shown by a small quantity of carbide falling, then place it in position in the generator. Connect the top tap, by means of a rubber tube, to the gas jet support, turn on this tap, and also the one on the gas jet. Place the gas bell in the water in its compartment gently, when it will sink and expel the air. As soon as it touches the top of the carbide holder, gas will begin to be made, and the bell will begin to rise. After it rises the second time, apply a light to the burner.

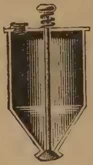


Fig. 2.

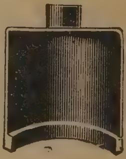


Fig. 3.

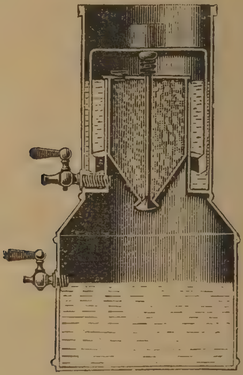


Fig. 4.

THE "PLANISCOPE" SUPPLEMENTARY LENSES.

Sold by J. J. Griffin and Sons, 20-26, Sardinia-street, Lincoln's Inn Fields, W.C.

The Planiscope Supplementary lenses are neatly mounted in metal, and their uses are thus described by Messrs. Griffin:—"The wide-angle Planiscope transforms an ordinary R.R. lens into a lens of as wide an angle as under ordinary circumstances is ever required. The same remark applies to the Telephoto. These two lenses are of great use in pictorial photography, as it frequently happens that a position is secured which is ideal except that the best part of the picture is too small on the plate, being too far away, and the foreground occupies too much space. By introducing the telephoto lens this difficulty is at once removed. On the other hand, sometimes upon focussing the picture much aggravation is caused by discovering that an object near to the lens occupies too prominent a position, and yet the camera cannot be moved, as otherwise the aspect is changed. By introducing the wide-angle lens the object in the foreground is toned down into a position more in harmony with true composition. The Portrait lens, in addition to making the taking of portraits possible with an ordinary R.R. lens and a camera of short focus, gives a softness and delicacy which is usually obtained with a portrait euryscope. The Copying lens is useful where the operator wishes to photograph an image of the same size, and has not a long extension to his camera."

THE BECK-STEINHEIL CONVERTIBLE ORTHOSTIGMATS.

Manufactured and sold by R. and J. Beck, Ltd., 68, Cornhill, E.C.

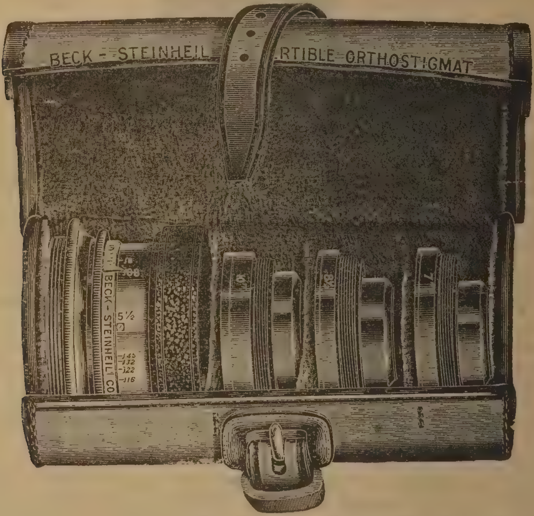
To meet the demand for sets of convertible lenses, Messrs. R. and J. Beck, Ltd., have composed four sets useful for plates from lantern or smaller to half-plate or 7×5, of which they send us the following particulars:—The sets are arranged by selecting single combinations from the Series I. of the Beck-Steinheil lenses, and adapting them so that they will all screw in register in one mount, thus obviating the necessity of having a number of complete lenses. By this system the possessor of three single combinations has at his disposal lenses of six different foci, varying in rapidity from *f*-6.8 to *f*-7.7 and of *f*-12.5, and giving foci in the case of the quarter-plate, as detailed below:—

SET NO. II.—FOR 4¼ × 3¼ PLATES.

Half Comb. of Lens No.	Focus.	Aperture.	Angle.	Plate covered.
2	7 in.	*f*-12·5	41°	6½ × 4¾
3	8½ ,,	*f*-12·5	36°	8 × 5
4	10 ,,	*f*-12·5	30°	9 × 6
2·3	4½ ,,	*f*- 6·8	62°	4½ × 3½
2 4	5⅛ ,,	*f*- 7·7	54°	5 × 4
3·4	5½ ,,	*f*- 6·8	49°	6 × 4

Each set is made up as follows:—

1. A setting or mount, into which any combinations will screw, either in front or behind the iris in register.



2. Three combinations of the Beck-Steinheil Orthostigmat Series I. of foci as selected and working at *f*-12.5 respectively, each being clearly engraved with its equivalent focus on its cell.

3. A special reversible aperture ring engraved with diaphragm sizes for all six lenses.

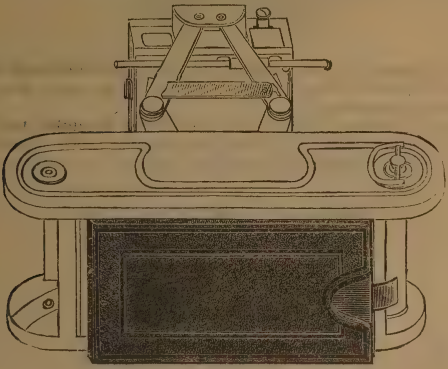
4. A hood carry a cap to screw into the lens mount when no combination is used in front of the iris.

5. A solid leather sewn case to take all the components. There being only one iris diaphragm and six different foci, some confusion might arise over the apertures; but this is overcome by the use of the reversible cover tube or aperture ring, which slips over the ordinary lens mount, and contains all the apertures for the lens when used as either of the three doublets, the apertures for the single lens being engraved along one edge of the aperture ring, and those for the doublet on the other edge. To change from one to the other, the ring is simply reversed. This is supplied with all the sets.

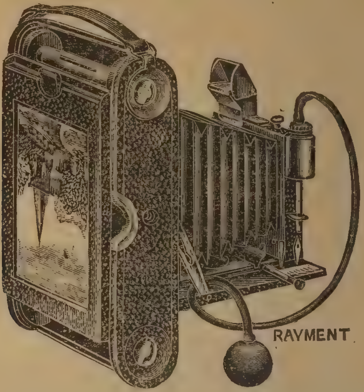
USEFUL ADJUNCTS TO FOLDING POCKET CAMERAS.

Wholesale agent: Arthur Rayment, 125 Earlham Grove, Forest Gate, London.

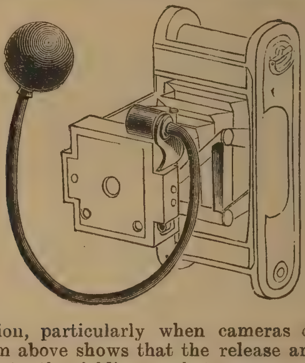
The Guénault Adapter, which permits the use of dry plates in folding pocket (film) cameras, is an ingenious device which has been brought to our notice by Mr. Arthur Rayment. It comprises (1) a neat rectangular frame, which is so exactly fitted that it attaches itself by friction to the folding pocket cameras without addition or alteration; (2) three single slides (to fit into the frame), about ½-inch thick, which are absolutely light-tight, and the three together weighing slightly over 4½ ounces; (3) a loose frame, arranged to increase the distance between lens and plate when objects only 40 inches distant are to be photographed; (4) two nickeled metal bars, supplied with the necessary rivets; these bars can be readily riveted to the jointed struts in front of the extended apparatus in such a manner as to alter the focus by varying the width between the jointed struts, thereby lessening the distance between lens and plate. The foregoing detail, with the accompanying diagram, makes quite plain the simplicity and utility of the Guénault Adapter.



It affords two advantages:—Firstly, the means of employing plates; and, secondly, the means of adjusting distance between lens and plates in folding pocket film cameras; and, further, it enables the operator to photograph very near as well as distant views, and to obtain with the folding pocket camera portraits, the size and style of which may be varied from the full-length to the large bust. Stock is kept in readiness of these plate adapters, and shutter releases, to exactly fit those elegantly-modelled Kodaks of the Eastman Company's manufacture, known as Nos. 1, 1a, 2, and 3. The adapters for the last-mentioned three sizes are fitted with focussing screens, so that the image may, when desired, be viewed before exposure.



The Guénault shutter release has also been brought to our notice by Mr. Rayment. To make successful pictures with short-timed exposures, a shutter possessing pneumatic release is essential for the avoidance of vibration, particularly when cameras of light weight are in use. The diagram above shows that the release arrangement attaches itself in a moment to the folding pocket camera, and may be again disconnected from it with equal rapidity. The rubber bellows within the slotted nickel metal cylinder releases the trigger, and holds open the shutter during the more or less prolonged (timed) exposure required.

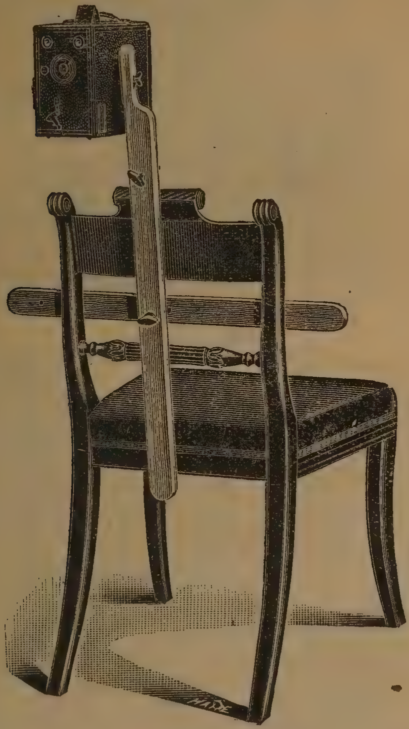


We may add that we regard both the adapter and the shutter release as unquestionable advantages, giving efficient assistance to those desirous of obtaining perfect results. Their cost is such as to place them within the reach of all folding pocket-camera photographers.

THE "GRIPPER" CAMERA SUPPORT.

Manufactured and sold by Geo. Houghton and Son, 88 and 89 High Holborn, W.C.

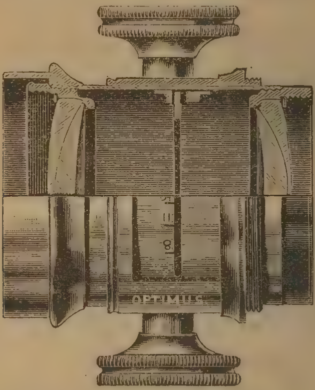
THIS is a device for attaching a hand or stand camera to a chair, etc., for home portraiture, copying, or photography in situations where an ordinary camera stand cannot be conveniently used. The "Gripper" is readily attached to any chair, table, mantelshelf, door, gate, fence, and is also adaptable for copying a photograph or other object in a vertical position. The illustration shows the apparatus in use on a chair, and in this case, and on all similar objects, the centre screw only is used, its purpose being to draw the two arms closely together, thus gripping the chair tightly at four points.



THE "GROSSAR" LENS FOR ENLARGING, &c.

Manufactured and sold by Perken, Son, and Co., 99, Hatton-garden, E.C.

This lens is a special introduction by Messrs. Perken, Son, and Co., Ltd., whose apparatus bearing the "Optimus" trade-mark is known to every photographer. It is an instrument expressly designed for the enlarging lantern, and combines fine definition with great rapidity and flatness of field. The series consists of three sizes of 7, 10½, and 15 inches focus for use respectively with condensers 5 to 6, 7 to 8, and 9 to 10 inches in diameter. The intensity of the lens at full aperture is f-5.75. It will be seen from the illustration that the lens is of the rectilinear class, a type which has earned a deservedly high reputation for freedom from spherical aberration. A rack-and-pinion movement is provided for fine adjustment of the focus, and the iris diaphragm, with which the lens is fitted, will be a welcome substitute for the old Waterhouse stops. A focussing cap of orange glass is also provided. The tests to which we submitted the 10½ inch lens placed at our disposal gave most satisfactory results, and we think the instrument should not only be of great value to the enlarger, but also to the lanternist.



SUTER'S ANASTIGMATIC LENSES.

Manufactured and sold by E. Suter, Basle.

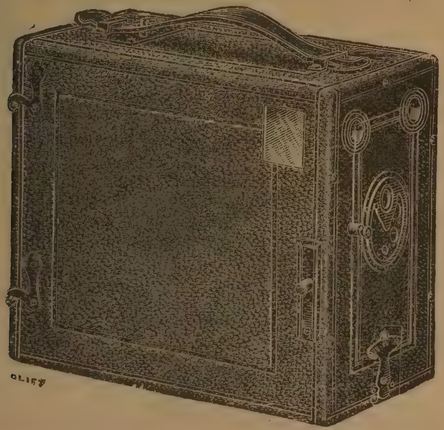
Mr. J. R. Gotz, of 215, Shaftesbury-avenue, submitted for our inspection three specimens of a new anastigmatic lens recently constructed by the well-known optician, Mr. E. Suter, of Basle. The type is known as Series I., and, to some extent, resembles in its construction the well-known double anastigmat of C. P. Goerz. However, in this lens each combination is composed of four elements. No particulars of the glass used are given in the prospectus beyond the fact that the four elements are of different kinds. To convey an idea of the construction of the lens, we would mention that the double concave middle element of the

Goerz type appears to be replaced in the Suter anastigmat by a negative meniscus and a crossed double cancave. We thus have in the construction of the combination an outer double convex, followed by a negative meniscus, a crossed double concave, with the flatter curve in front, and, lastly, a positive meniscus. The three lenses submitted to us are Nos. 2, 3, and 4 of the series, their respective foci being 175, 205, and 270 mm. The quality of definition is of a high order, and the flatness of field excellent. The lens of 175 mm. (6⅞ in.) covers a 7×5 in. plate well at full aperture, whilst with smaller stops it may be used for plates up to 9×7 in. The next size of 205 mm. (8 1-16 in.) focus, covers plates from 8×6 in. to 12×10 in., according to aperture, and the lens of 270 mm. (10⅝ in.) focus is designed for plates 9×7 in., and, with small stops, will cover 15×12 in. According to the maker's description, these lenses have an aperture of f-7.2, but we found No. 2 not quite of this intensity. The rapidity of these lenses, their flatness of field, and wide angle of covering power should make them favourites with photographers for most purposes. Mr. Gotz is the London agent.

THE HOLBORN HAND CAMERAS.

Manufactured and sold by Geo. Houghton and Son, 88 and 89 High Holborn, W.C.

To their series of "Holborn" hand cameras Messrs. Houghton inform us that considerable improvements have recently been added, the principal of these being a variable speed adjustment to the shutter, which also admits of time exposures. Of one of the instruments, that selling for a guinea, we subjoin the following details. It is covered with a waterproof material of a hard surface, and in appearance resembling leather. The lens, a single achromatic, is controlled by rotary stops, adjustable from the outside, and the shutter before-mentioned. There are two finders, and sheaths for plates, and the changing arrange-

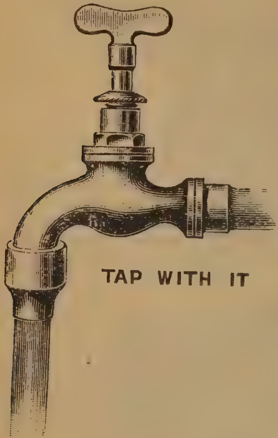


ment actuates a recorder which indicates the number of plates exposed. The external dimensions of the camera are 7½×6½×4. A similar camera is fitted with a doublet instead of a single lens.

A TAP FILTER.

Manufactured and sold by the Torton Manufacturing Company, Wigan.

THIS is a little dark room convenience to the utility of which we can testify from practical trial. The fitting is lined with rubber so that it is easily attached to the tap; inside there is a finely perforated gauze disc, which so regulates the down flow of water, that it reaches the dish or measure in a solid stream without splashing. Of course, it also acts as a filter for the coarser impurities the water may contain. The free easy flow is a thing we have much appreciated in sink work in the dark room.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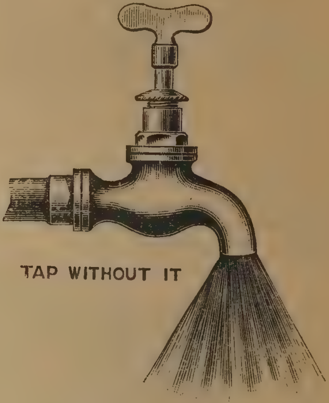
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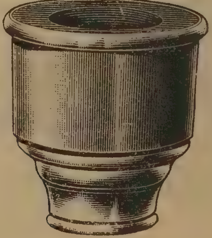
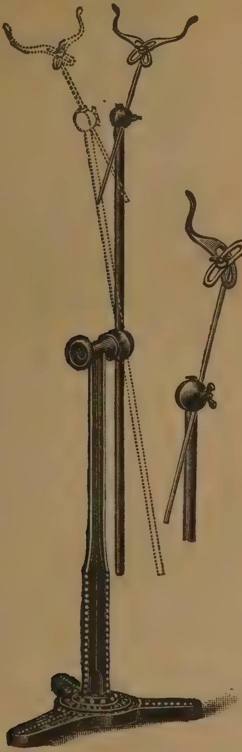


THE "SICKLE" HEAD-REST AND SCREEN.

Manufactured and sold by O. Sichel and Co., 52, Bunhill-row, E.C.

Finished in black and gilt, the head-rest shown in the accompanying illustration has some movements and adjustments which deserve the notice of those who in studio work expect an accessory of the kind to answer a variety of requirements. Thus, as shown by the dotted part

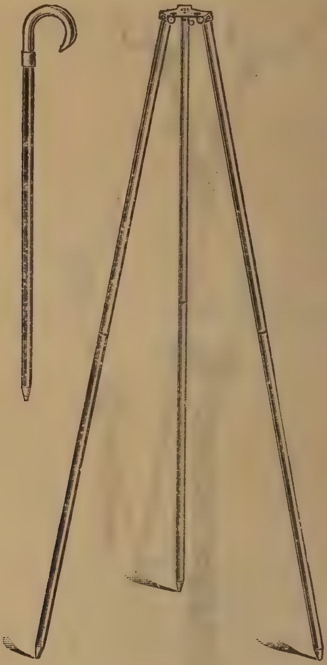


of the diagram, the upright rod may be swung to the right or left, and clamped at any desired angle or height. A universal ball joint allows of similar controls over the cross-rod whilst slots in the ear-prongs permit these to be adjusted to the head. In the majority of studios it is probable that the head-rest will long remain in use. The form to which we are here referring appears simple and convenient to manipulate.

THE "PRACTICAL" WALKING STICK STAND.

Manufactured and sold by Geo. Houghton and Son, 88 and 89 High Holborn, W.C.

The latest adaptation of the camera stand to the form of a walking stick has many features which recommend it to the notice of those with whom portability of apparatus is a desideratum. It is made of steel tubing, the joints sliding one into the other. The outer tube is enamelled black. A 3¾ in. metal top, with a screw, is provided, and this, when detached, can be conveniently carried in the pocket. To complete the walking stick a nickel-plated crook handle is supplied. The dimensions are: Height when set up in use, 58½ inches; length of stick when closed, 34 inches.



WRITEIT BOTTLES.

J. J. Griffin and Sons, Ltd., 20-26, Sardinia-street, London, W.C.

Although these bottles are not new, they have lately been much improved. They are provided with a plain white matt badge, on which the name of any chemical can be written with lead pencil, which can be easily removed with a damp sponge, should the bottle be required for some other chemical or solution. The stopper provided with these bottles is a combination of the "grip" shape, which permits of its easy removal, and it has also a flat head, which prevents dust from collecting on the lip, and, as this head is octagonal and not round, there is no danger of its rolling off the bench. They are made both with narrow and wide mouth, and will be found of great convenience, and a great advance over the ordinary type.

THE "FLASHAXE" CANDLE FLASHLIGHT.

Fuerst Bros., 17 Philpot Lane, E.C.

A brilliant flash of some seconds' duration is obtained by the ignition of the touch paper at the top of the little candle shown in the annexed illustration. We should imagine that these compact little candle flashlights would be found useful by the amateur taking photographs at home in the evening. They certainly answer their purpose very well. We append the instructions issued by Messrs. Fuerst:—The candle is not dangerous, it burns without noise, does not spurt, and does not explode. Fix the candle on a fire-proof base (its position should be slightly above and at one side of the camera). Light the small tape at top of candle with a match, and after 2-6 seconds the flash commences. It is advisable

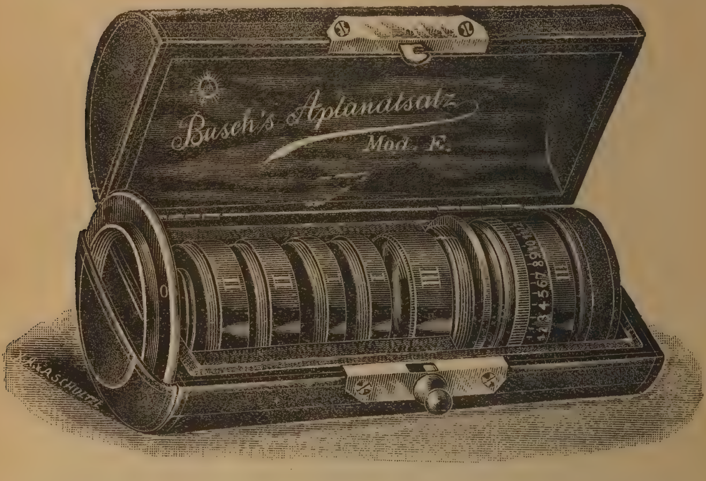
FLASHAXE
(FLASHLIGHT) CANDLE

to fix the candle (especially the large sizes) by means of a drop of stearine to the fire-proof base, so as to avoid the candle toppling over during exposure. If the operator wishes to photograph himself, he must not fire the tape, but it is recommended to fix to it a piece of touch paper vertically (about ¼-inch wide). The commencement of the exposure is dependent on the duration of the burning of the touch-paper. When the candle is alight, the whole of the shell burns off, thus giving a very fine and extended source of light (at the back of the candle any sort of white reflector may be placed). The candle must be kept in a dry fireproof place. For interiors it is recommended that mirrors and very bright objects should be "matted" by rubbing them over with soap, to avoid halation.

BUSCH LENS SETS.

The Rathenower Optische Industrie-Anstalt. Henry F. Purser, agent,
31, Hatton-garden, E.C.

The Busch f-8 aplanat set, while not offering the variety of combinations of the vade-mecum set, has the advantage that, the various aberrations being corrected, a larger working aperture is given, and better definition secured, without the necessity of using the smaller stops. The set consists of a brass mount with iris diaphragm, and three sets of symmetrical combinations (six lenses in all) which, separately and in combination, give eight different foci from 6 to 20 inches. The covering power of the various lenses extends from 3¼ × 3¼ to 20 × 16, so that the set can be used on any camera within these dimensions. The use of the smaller diaphragm increases the covering power to two and three sizes larger than the normal plate. The lenses can therefore be used for wide-angle work.



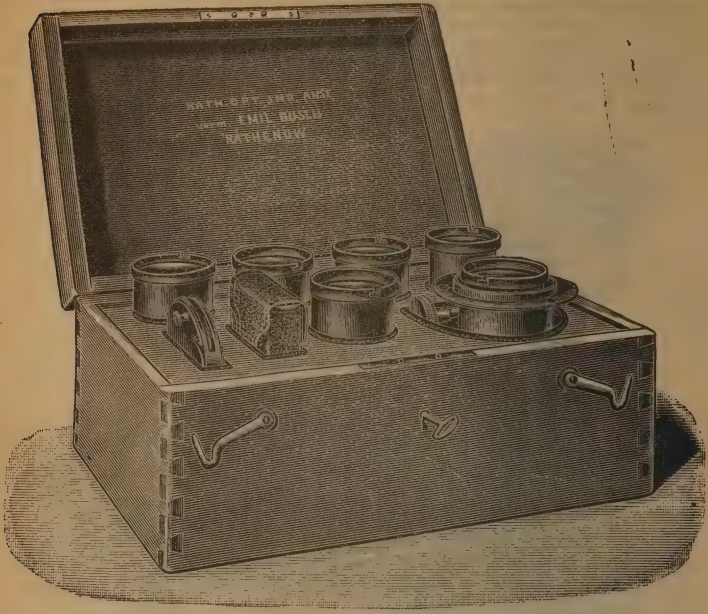
THE BUSCH F-8 APLANAT SHUTTER SETS.

Consist of aplanat lenses, mounted in cells to fit interchangeably to the "Unicum" shutter, which has time and instantaneous movements from 1 to 100th of a second, with pneumatic and finger relase. The shutter works between the lenses, and the Iris diaphragm forms part of the shutter mount. Three models are made, giving lenses singly and in combination of 5 to 8 different foci. Models A and B are useful for cameras of ¼, 5×4 and ½-plate sizes. Model C up to whole-plate size. Each set is neatly fitted into a brown leather-covered case, easily carried in the coat pocket. A card, giving tables of combination and F values, accompanies each set. Model A consists of the unicum shutter and four lenses mounted in cells. These lenses in combination give three different foci of 6, 7, and 8 inches, and singly, 12 and 16 inches. Model B consists of the unicum shutter and six lenses, which, in combination, give foci of 4¾, 5½, 6, 7 and 8, and singly, 9½, 12, and 16 inches. Model C consists of the large size unicum shutter, with six lenses, which, in combination, give foci of 6, 7, 8, 9, and 10, and singly, 12, 16, and 20 **inches.**

THE LENSES OF THE BUSCH ACHROMATIC PROJECTION SET

are constructed on the Petzval formula, and mounted in brass cylinder tubes, interchangeable, to fit the jacket. The set consists of the following:—1. The brass jacket with flange and double rack and pinion.

2. Objectives in brass tubes; lenses 2 in. diameter; equivalent focus, 6, 8, 10, 12, 14, and 16 inches. 3. Brass top, with flasher and slot for the insertion of coloured glasses (made to fit easily to any of the objectives by means of a bayonet joint). 4. A set of six coloured glasses for projection purposes, consisting of tinted foils, mounted between glasses, in leather case.



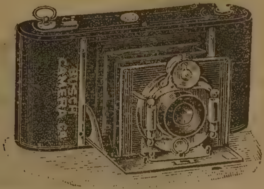
NEW BRASS MOUNTED TRIPLE CONDENSERS.

The lenses consist of two plano-convex condensers, with the addition of a periscopic lens, which can be easily detached, and the ordinary plano-convex combination used alone. The advantage of the additional lens is, that according to circumstances, the amount of light given is from two to five times greater than that given by the ordinary condenser of two plano-convex lenses. As an example of the effect of the periscopic lens in shortening the focus of the double plano-convex condenser, that of 6¼ inches diameter is, used alone, 5 inches in focus, and the addition of the periscopic lens reduces its focus to 3 inches.

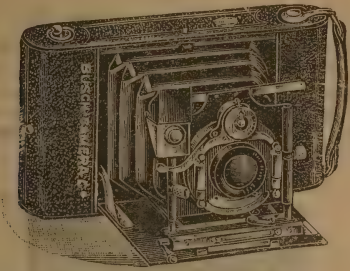
NEW "BUSCH" CAMERAS.

The Busch Camera Company, 31, Hatton-garden, E.C.

The Pocket Film Camera is for daylight loading spools 3¼×2¼, 12 exposures. The body of the camera is constructed of mahogany and aluminium, and is covered with black-grained leather. It is fitted with a "Busch" detective aplanat, f-6, and a unicum shutter. The front draws forward, and locks automatically into position for objects at or beyond the infinity point. For nearer objects the point can be drawn forward and clamped into position, according to the scale at the side. The dimensions of the camera closed are, $7 \times 3\frac{3}{8} \times 1\frac{7}{8}$ inches, and the weight 19 oz.

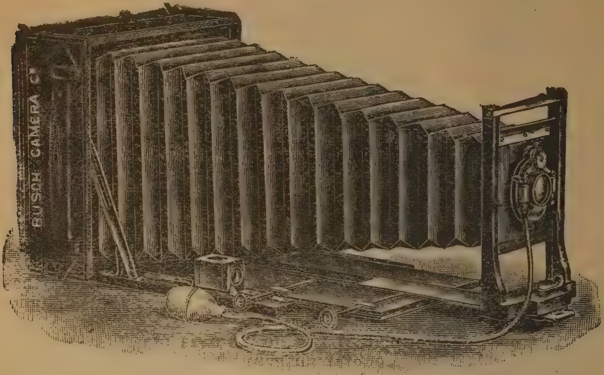


The "Busch" quarter-plate pocket camera is of the folding pocket type, the body being made of mahogany and aluminium, and covered with black grained leather. It folds up to the thickness of a book, and can be carried in the coat pocket. It has a rising and sliding front. The front is drawn out and fixed automatically at infinity point, and focussing adjustment is provided for objects at shorter distances. The other features of the camera are:—"Busch" lens. Detective aplanat No. 2, f-6. Unicum shutter with time and instantaneous movements from 1 to 100th second. Reversible view finder. It takes the roll cartridge films $3\frac{1}{4} \times 4\frac{1}{4}$, 12 pictures, and can be reloaded in daylight. The size of the camera is $7\frac{7}{8} \times 4\frac{3}{4} \times 1\frac{3}{4}$, and the weight, 23 oz.



THE LONG EXTENSION FOLDING CAMERA,

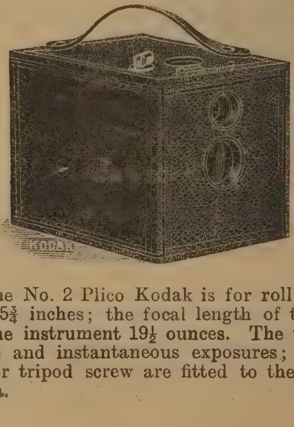
for 5×4 plate, is a camera of the popular American type. The body is of mahogany, with fittings of brass, and covering of black grained leather. It has rack and pinion focussing adjustment, and the extra long bellows extension of 17 inches, being suitable for use with sets of lenses such as Busch's aplanat sets, the bellows extension being sufficient to enable the photographer to use all combinations of the sets and many of the single lenses also. It has vertical and horizontal swing, reversible back, rising front, etc., reversible view finder.



THE NO. 2 PLICO KODAK.

Manufactured and sold by Kodak, Ltd., 43, Clerkenwell-road, E.C.

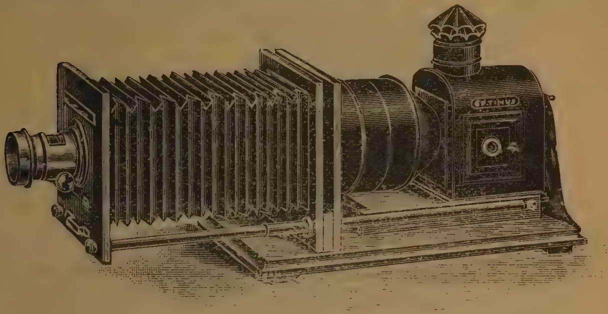
The No. 2 Plico Kodak is issued in place of the No. 2 Falcon. Its distinguishing characteristic is the manner in which the camera is opened for the purpose of loading or unloading; the outer case being readily removed, so that both the receiving and unwinding spools are made easily accessible. The No. 2 Plico Kodak is for roll film pictures $3\frac{1}{2}\times3\frac{1}{2}$; it measures $4\frac{3}{8}\times4\frac{1}{2}\times5\frac{3}{4}$ inches; the focal length of the lens is $4\frac{1}{2}$ inches, and the weight of the instrument $19\frac{1}{2}$ ounces. The usual ever-set rotary shutter, giving time and instantaneous exposures; set of three stops, finder and socket for tripod screw are fitted to the No. 2 Plico, which retails at one guinea.



THE "OPTIMUS" PROFESSIONAL ENLARGER.

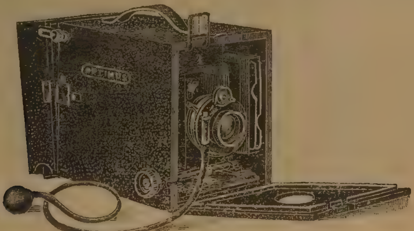
Manufactured and sold by Perken, Son, and Co., 99, Hatton-garden, E.C.

The firm of "Optimus" (Perken, Son, & Co., Ltd.) has long devoted itself to the careful study of enlarging apparatus, and different forms of these instruments, suitable for various illuminants, have been produced. The latest model is that shown in our illustration, which gives a much increased bellows adjustment, thus permitting a wide range of usefulness. The light chamber allows of any illuminant being employed, from the oil lamp to the most powerful electric arc lamp. The materials used, and the workmanship and finish, are of the very finest quality.



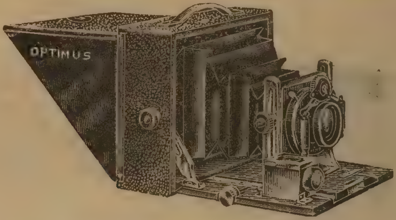
THE "OPTIMUS" UBIQUE CAMERA.

A hand camera that has been quite brought up to modern requirements is the "Optimus" Ubique shown above. This model of camera was introduced by Perken, Son, & Co., Limited, some years ago, and improvements have continually been added, until now there appears nothing to be desired. The latest additions are:—a between-lens shutter actuated by ball and tube, and a very simple and convenient view finder, which, when not in use, folds away, and is contained inside the camera. The instrument is covered in excellent leather, and is neat, compact, and eminently efficient.



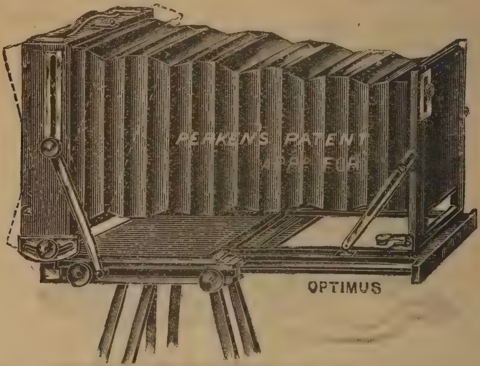
THE "OPTIMUS" KOPIT CAMERA.

An exceedingly neat and compact instrument is the "Optimus" Kopit hand camera manufactured by Perken, Son, & Co., Limited. The instrument is most carefully thought out, and has every movement, rack and pinion focussing giving a great range of extension; swing back, rising and falling front, etc. The shutter is fitted between the lens combinations, and is released by a pneumatic ball. The finder is of the "brilliant" type. There is a hood to cover the ground-glass screen, which, besides being of great assistance in shading the glass whilst focussing, ensures the screen from damage when folded up for insertion in the pocket. The camera is supplied with three or more double dark slides.



THE "OPTIMUS" SWING BACK CAMERA.

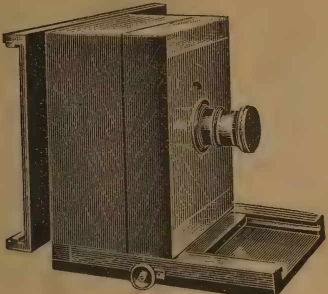
The illustration shows an improved taper bellows camera manufactured by Perken, Son, & Co., Limited, of Hatton-garden, London. As will be seen by the diagram, the instrument is provided with a central swing to the back, thus overcoming one of the most serious drawbacks to that popular form of camera. The central swing is obtained without any sacrifice of rigidity.

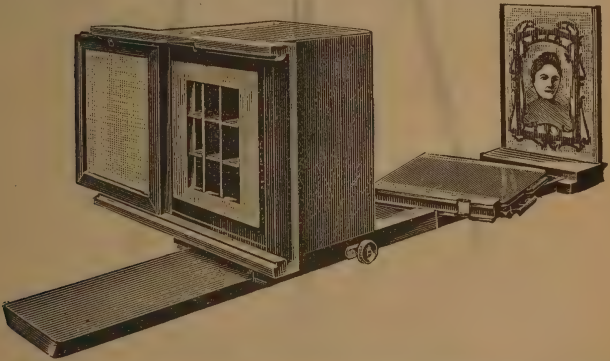


THE "APTUS" STUDIO CAMERA.

Manufactured by Sharp and Hitchmough, Dale-street, Liverpool.

To those photographers who make it their business to produce gem, postage-stamp, or Victoria portraits, in addition to the usual larger sizes, the "Aptus" studio camera will be found to be an extremely useful piece of apparatus. For ordinary work, that is to say, for taking cabinets or cartes, the camera is simply a convenient form of studio camera, square, so that either a vertical or horizontal half-plate picture may be made, and with a repeating back and slide for taking two quarter-plates. The carte or cabinet lens being removed, fittings are provided for a set of gem lenses—either 9 or 16, as required, or a set of Victoria lenses, the necessary internal arrangements of the camera being, of course, also provided for. The camera outfit also includes a long baseboard with adjustable easel for copying.

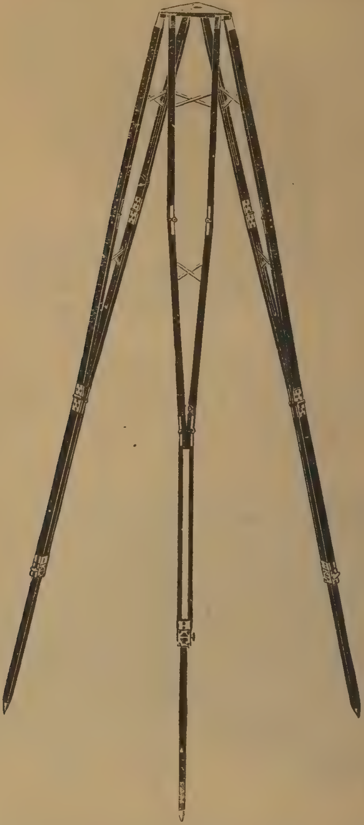




THE "GIRAFFE" SLIDING AND FOLDING TRIPOD.

J. Ashford, 179, Aston-road, Birmingham.

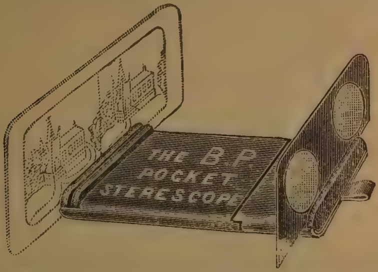
The "Giraffe" is a four-fold stand, two of the connections being hinges, and the third a sliding joint. When folded for travelling, the legs occupy the space of $15\frac{3}{4} \times 2\frac{1}{2} \times 2$ inches. When erected and in use the stand allows the camera to be used at the height of five feet from the ground, or, by running up the sliding section, it may be used at an inch or so over three feet from the ground without unduly spreading the legs. There are no projections or loose parts, and the stand may be quickly erected.



THE "BEST PORTABLE" STEREOSCOPE.

Manufactured and sold by W. Tylar, 41, High-street, Aston, Birmingham.

THIS form of stereoscope, which Mr. Tylar aptly calls the "B.P.," is portable enough when closed to be carried in the coat pocket without inconvenience, for it measures only 7½ in.×4 in.×½ in., and weighs 4 oz.

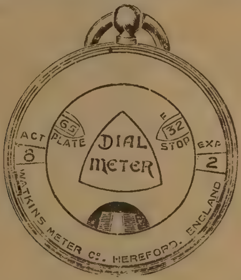


In fact, as it is pointed out, it "looks like a cigar case, only a little longer." The illustrations show how the instrument is packed or set up. It costs only 1s. 9d., and quite answers the purpose of enabling stereo slides to be examined binocularly without inconvenience.

THE WATKINS DIAL EXPOSURE METER.

Manufactured and sold by the Watkins Meter Company, Hereford.

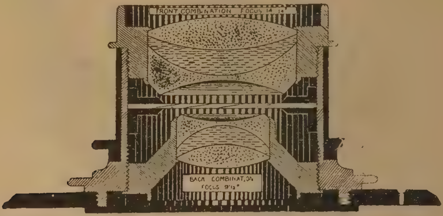
THE plate, f stop, actinometer, and exposure data, it will be observed, are obtained by rotary movements controlled from the face of the instrument. A blue film facilitates the matching of the tint, and, as usual, the chain can be used for timing seconds. Revolution of the back case of the instrument admits of the movement of the sensitive paper. As Mr. Watkins points out, no figures are in sight except those in use. For the purpose of calculating exposures the instrument is the acme of simplicity. The plate and stop numbers being set, the revolution of the glass face practically "does the rest." Of gentleman's watch size, the dial meter is finished in nickel. The engraved stop values range from f-5.6 to f-40, and the range of plate speeds from 11 to 500.



THE BECK-STEINHEIL CONVERTIBLE ORTHOSTIGMAT.

R. and J. Beck, Ltd., 68, Cornhill, E.C.

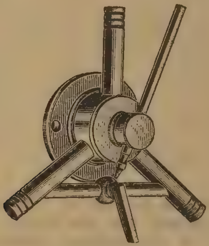
This series has been introduced to provide for the wants of those who require to use lenses of various foci, and to avoid the necessity of carrying a battery of lenses. The single combinations, used alone, form landscape lenses, working at f-12.6. Two single combinations, either of the same focus, or of different foci, are used together to form a rapid doublet, working at either f-6.8 or f-7.7, according to amount of dissimilarity in the focus of the two single lenses employed. The number of variations in focus that can be obtained varies according to the number of single combinations which form the battery. Thus, with single combinations of 7 and 8½ inches focus, in addition to those lenses, the two form a doublet of 4½ inches focus. The same two lenses, with the addition of one of 10 inches focus, will form three doublets—the 7+the 8½=4½ inches, the 7+the 10=5⅛ inches, and the 8½+ the 10=5½. The doublets, used with small stops, form wide-angle lenses. that is, they cover a large plate in comparison with the focus of the lens.



LANTERN APPARATUS FOR ACETYLENE.

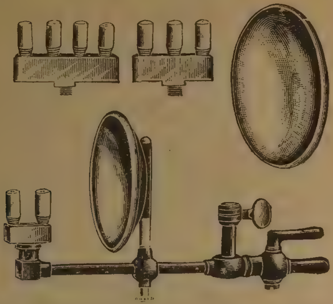
R. J. Moss, 98, Snow-hill, Birmingham.

The Moss dissolver for biunial lanterns is similar in appearance to the ordinary 3-way dissolver, but is especially adapted for acetylene, and is provided with a bye-pass. Every adjustment which is likely to be needed is possible. Thus, one full on, the other low. Both full on. Both out. All being effected by a continuous movement. The dissolving effect is perfectly carried out, and the lights cannot be turned out by accident.



THE NEW CHEAP LANTERN JET

provides for regular pressure to all the burners. It is made in four forms, for two, three or four burners, and the special jet has fittings to adapt either two, three, or four burners. Adjustable reflectors are provided in every case.



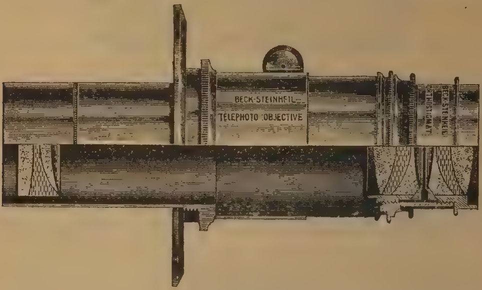
THE MOSS PURIFIER

is a modification of that in use for ordinary lighting installations, and is adapted for either two, three, or four burners, according to size and capacity. It removes the impurities which give rise to the unpleasant odours of the unpurified gas, and improves the light. The purifier needs no attention until the material is exhausted. With ordinary use a charge of purifying material will last a season. Each purifier is fitted with an improved filtering arrangement in addition to a large condensing chamber.

THE BECK-STEINHEIL TELE-PHOTOGRAPHIC LENS.

Manufactured and sold by R. & J. Beck, Ltd., 68, Cornhill.

The attachment is composed of three lenses cemented together—the first a meniscus, the second a double concave, and the third another meniscus of a lower magnifying power than the first. The surfaces do not vary as much as 1-20,000 in. The attachment has only two reflecting surfaces, and thus, when combined with a positive, the increase of loss of light from this source is not of vital importance. Adverting to the special uses of a negative attachment, Messrs. Beck point out that it often occurs, particularly in landscape and architectural photography, that the object to be photographed is situated at such a distance that it cannot be obtained by a lens of the usual focal length without rendering the picture too small; on the other hand, if an ordinary lens of very long focus is used, the extension of the camera so necessitated is often unobtainable, or, if obtainable, makes the instrument cumbersome. These difficulties are overcome by the addition of a lens of negative focus to the ordinary objective. The addition of this in no way interferes with the use of the ordinary lens for other photographic purposes. This negative lens produces the following effects:—It considerably increases the length of the complete tele-photo system, as compared with the focal length of the positive element. It displaces the optical centre to a point in front of the photographic lens. It renders a large number of different foci available. It reduces the rapidity of the lens. The field of this particular tele-photo attachment embraces an angle of about 10° or 15°.

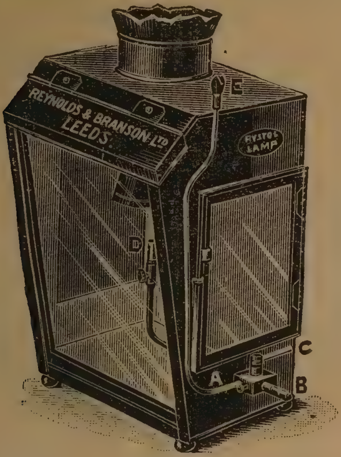


This lens has been specially corrected for astigmatism and spherical aberration, and to give as flat a field as possible. The importance of this is obvious when it is remembered that the tele-photo lens magnifies all errors present in the positive, according to the magnification in use, besides adding its own errors. From this it can be gathered that it is as equally important to have a first-rate negative element as it is to have a first-rate positive element, and a badly corrected or badly adjusted tele-photo element combined with the very best procurable positive lens will not give satisfactory results. The Beck-Steinheil tele-photo attachments are all engraved with the magnification procurable at the various separations, whether it be one of the orthostigmats or any other lens that is fitted to it. The mount is the usual brass rack-and-pinion one.

THE RYSTOS LAMP.

Manufactured and sold by Reynolds & Branson, Leeds.

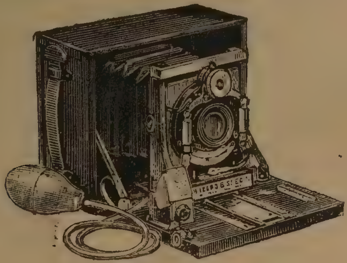
This is a useful form of lamp for dark-room purposes. The sloping front has three grooves, so that variety as well as combination of illuminants may be obtained. Windows of ruby glass are placed at each side, and the interior has a gas jet controlled externally by the tap shown at C. A bye-pass is shown at E. The lamp, which is painted white inside is japanned black outside, and has a metal cowl, not shown in the illustration. We have had a similar lamp in successful use for a considerable time, and can therefore speak from practical experience of the value of the "Rystos."



A NEW "WIZARD" CAMERA.

Seabrook Bros. & Co., Edmund's-place, Aldersgate-street.

This is the Wizard Special, after the American pattern, and is one of the most compact of its kind. Its extension for so small a camera is considerable, having a length of bellows 10½ inches for the quarter-plate. The adjustments are very complete, and it might well be termed a "camera de luxe" in general appearance. It is fitted with the Wizard

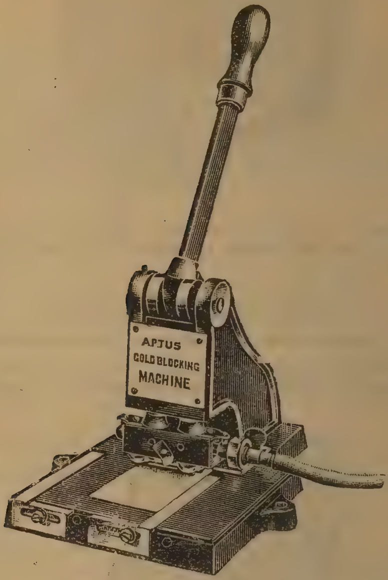


R.R. lenses. Seabrook Brothers, who will be putting the camera on the market shortly, also have a new daylight-loading film attachment for it.

THE "APTUS" GOLD BLOCKING MACHINE.

Sharp & Hitchmough, 101 and 103, Dale-street, Liverpool.

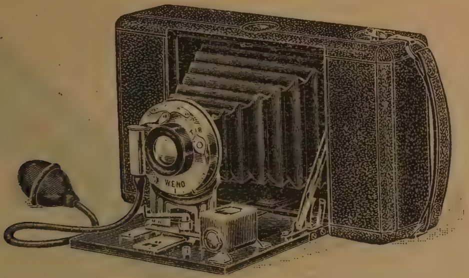
This is a small lever press for the use of photographers, ticket writers, printers, etc., who have occasion, from time to time, to make block impressions, either plain or in gold, bronze, or colour, upon photographic mounts or similar things. The illustration gives a good general idea of the form of the apparatus. The block from which the impression is to be made may be either of incised brass, or it may be an electro, and arrangements are made for heating it to the required temperature for the particular purpose for which it is being used. Briefly, the operation consists in placing the card to be impressed on the bed of the press and pulling the lever, the incidence of the impression on the required place having been secured by setting guides. There are, of course, conditions that have to be observed to obtain the most successful results, but complete instructions are supplied with the apparatus.



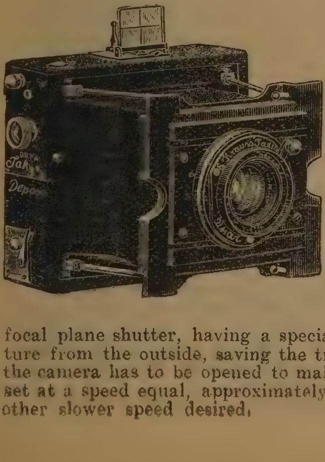
THE "WENO" FILM CAMERA.

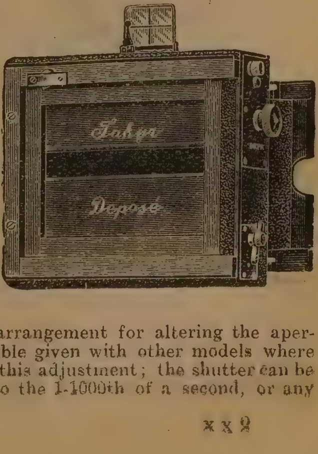
A. E. Staley & Co., 35, Aldermanbury, E.C.

The general construction of this camera will be apparent from the illustration. When closed it measures 9×5×2 inches. It is made in two sizes, $\frac{1}{4}$-plate, and 5×4. The 5×4 will take Kodak, Blair, or any kind of film on standard spools. The camera is fitted with a rectilinear lens, Bausch and Lamb's new automatic "gem" self-setting shutter, with finger and pneumatic release. The finder is of the "Brilliant" kind, and reversible.



Messrs. Staley and Co. are also agents for the "Takyr." The special features are, that it is fitted with an extremely rapid lens, the Krauss-Zeiss Unar, working at f-4.5 and f-5. The camera is fitted with a focal plane shutter, having a special arrangement for altering the aperture from the outside, saving the trouble given with other models where the camera has to be opened to make this adjustment; the shutter can be set at a speed equal, approximately, to the 1-1000th of a second, or any other slower speed desired.

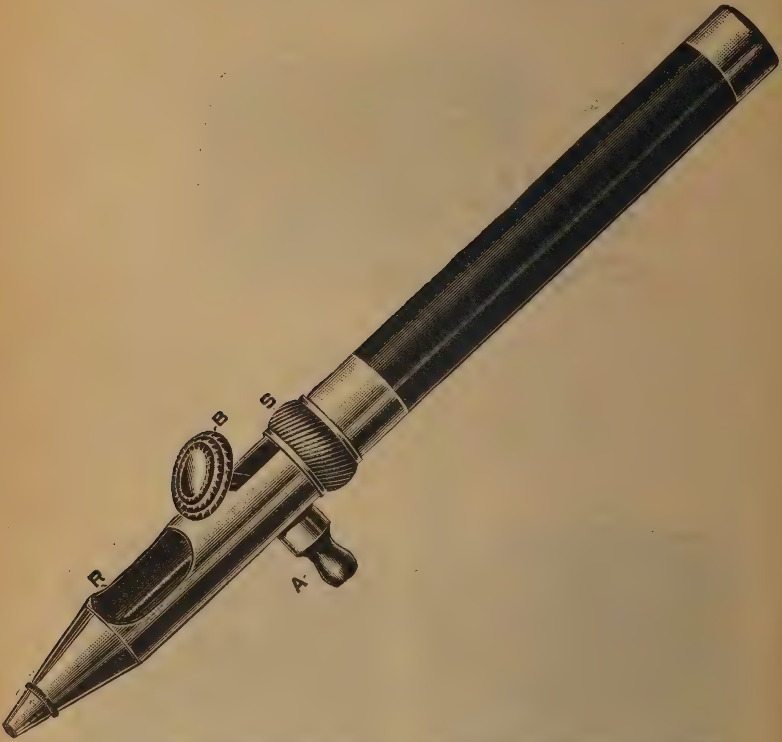




RECENT IMPROVEMENTS IN THE AEROGRAPH.

The Aerograph Co., Ltd., 30, Memorial Hall, Farringdon-street, E.C.

Among the improvements recently introduced into the Aerograph, perhaps the most important is the fine adjustment for regulating the supply of colour to suit fine work, such as finishing platinotype cabinets, small carbon pictures, etc. In the earlier form of the apparatus a screw was provided within the colour reservoir, which could be set to limit the forward movement of the lever; but, as the screw was not easily got at, and the enlargement itself required considerable care, this means of control was frequently left unemployed. The present instrument is fitted with a chased collar (S), the turning of which, by a cam arrangement, limits the forward motion of the lever B. It is now a simple matter, by the rotation of the collar, to adjust the instrument, so that, by mere downward pressure upon the button, uniform lines or dots of any desired degree of fineness may be produced.



Another improvement is the detachable nipple (A), which is fitted with a valve, so that the working part of the instrument may be unscrewed when not in use, leaving the nipple attached to the tube, the valve preventing escape and waste of air.

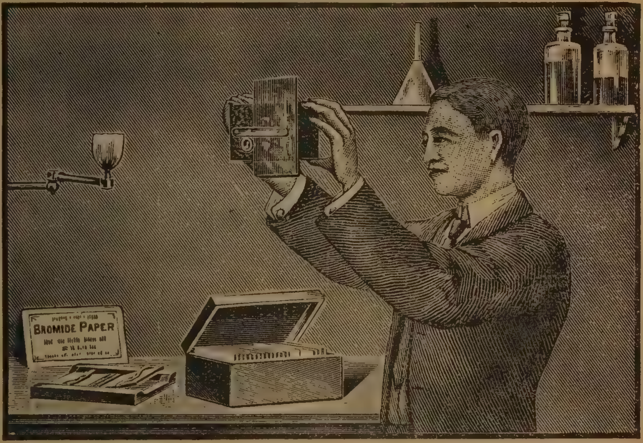
The instruments are now fitted with an improved form of cap, or suction nozzle, which secures better alignment with the discharge orifice, and a specially-packed chamber prevents the colour making its way into the working parts.

The Aerograph is now made of various sizes and designs, to suit such work as lithography, mural and ceramic decorations, etc.

DAWSON'S DENSITOMETER.

Geo. Houghton and Son, 88 and 89, High Holborn, W.C.

This is an instrument for testing the density of negatives when printing on bromide paper or other similar sensitive material. Light is allowed to pass through a portion of the negative under test to illuminate a ground-glass screen. A second screen, illuminated by light from the same source, is provided with a rotating wheel of diaphragm, according to the aperture of the diaphragm, which reduces the light on the second screen until it is of the same intensity as that passing through the negative. The negative is classified, and a reference to one of the tables contained in the booklet which accompanies the instrument gives the information as to exposure with the sensitive material it is intended to use.

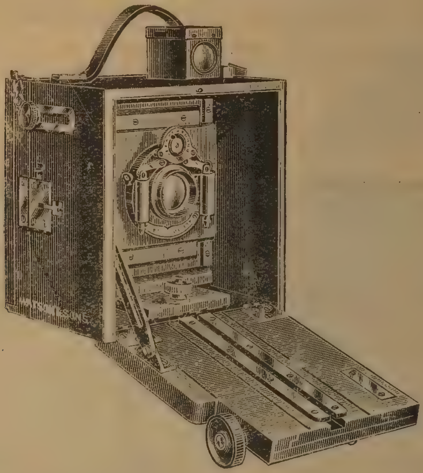


NEW CAMERAS, ETC.

Manufactured by W. Watson & Sons, 313, High Holborn, W.C.

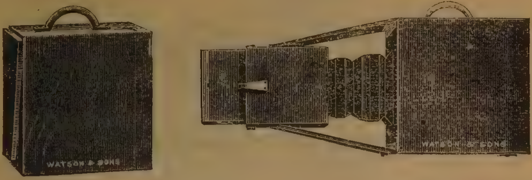
THE "ALPHA" CAMERA. IMPROVED FORM.

The camera is of box form, and is entirely self-contained—lens, shutter and finder packing inside the body. The lens and shutter are permanently in position on the camera front, and the apparatus can be instantly brought into use, the operation of focussing alone being necessary. This consists in drawing forward the front to a fixed stop on the baseboard, and then racking the base out until the pointer indicates the focus for the distance to the scale. The chief features of the camera are its long range of focus, and the amount of rising motion obtainable in the front. The baseboard is made (as shown) to fall below the horizontal, permitting the use of wide-angle lenses. The camera has reversing and swing back.



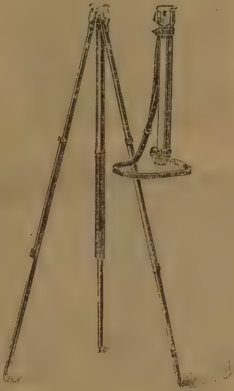
Another novel camera is designed for the production of nine "postage stamp" photographs upon a quarter-plate. The apparatus consists of a baseboard, upon one end of which is mounted the camera body, which is divided internally into nine chambers, each fitted with its own lens. Sliding along the baseboard is an arrangement for holding the photograph to be copied, which may be of cabinet or any smaller size. The exposures are, of course, made simultaneously, and the negatives, when developed, appear with an ornamental border round each small picture, which gives them the semblance of a postage stamp.

A new pattern of enlarging by camera has also been introduced during the year by Messrs. Watson and Sons. Folded, everything is enclosed in a box, and it is thus quite portable. For use, the part carrying the negative to be enlarged from is brought forward, and held steady by side wings, and the adjustments to suit the particular lens employed are obtained by means of a sliding body. A lens of about 8 inches focus is recommended. The camera is designed to enlarge from ½-plate negative, and enlargements may be made of any size up to 12×10. By fitting negative carriers the apparatus may be made to enlarge from ¼-plate or 5×4 negatives, but, naturally, a lens of shorter focus must be used.

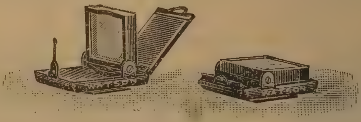


For use with this enlarging camera, and others of similar character, an illuminating attachment has been designed and introduced burning magnesium ribbon. The attachment is fitted to the negative carrier, and two, three, or more strands of magnesium ribbon are used, according to circumstances.

The Quickset tripod stand is a combination of aluminium and wood. The top joint is constructed of aluminium. The head is permanently fixed to the three top joints, and the camera screw, also, is fitted, so that it cannot be detached except by design. The middle portions of the legs are of wood, and slide into the angular space of the top joint; the bottom portions are also of wood, and they slide into grooves in the middle joint. The stand is surprisingly rigid and very portable.



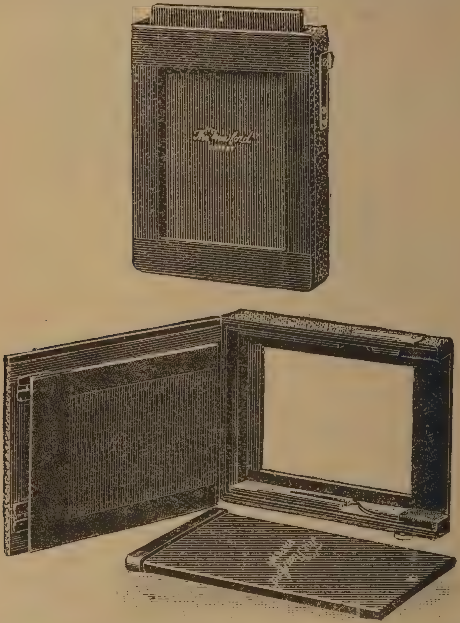
Watson's new folding finder closes compactly into a small space. The finder is of the double-concave lens type, marked with cross lines, and a foresight is provided. The image on the finder may be viewed directly, holding the camera on the level of the eye, or by means of a reflecting mirror, which may be set at the correct angle almost automatically: the camera may be held in the more usual position, and the finder looked down upon.



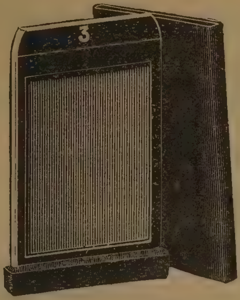
THE "NEWFORD" EXPOSING APPARATUS.

J. Ashford, 179, Aston-road, Birmingham.

The apparatus consists of an exposing frame, with a hinged lock, which takes the place of the ordinary dark slide; or it may be arranged so as to act also as a reversing frame. For focussing it is not necessary to remove the frame, but, by opening the back, the focussing screen



may be inserted and used. The plate holders hold each two plates, which are protected from light by a sheath or envelope. For exposure the exposing frame has its back opened, a plate holder is placed in it, and the back is closed. At this stage the end of the sheath protecting the plates projects slightly beyond the side of the exposing frame, so that it may be gripped and withdrawn. One plate is thus exposed to the lens, and the other is protected by the back of the exposing frame. It is a piece of apparatus which is difficult to describe with clearness and accuracy, but its mechanism is really very simple.

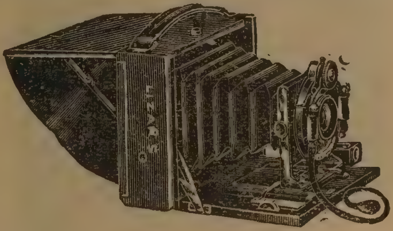


NEW "CHALLENGE" CAMERAS, ETC.

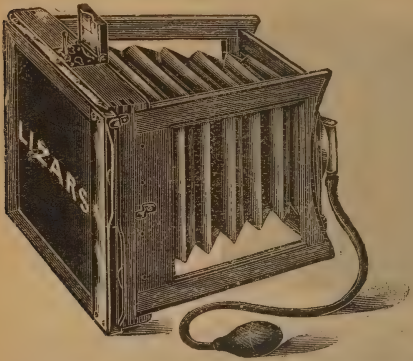
J. Lizars. London: 20, High Holborn, W.C.: Glasgow: 101 and 107, Buchanan-street.

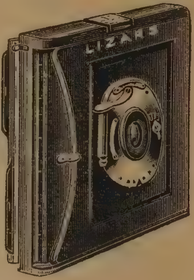
The Model C is of the popular folding pattern, equally suitable for use in the hand, or on a stand. When closed it is compact, and without outside projections. The camera is fitted with rectilinear lens and a Bausch and Lomb shutter. It has rising and cross points and swing back.

The focussing is by rack and pinion, and a scale is provided marking the focus at various distances. Three double dark slides are provided with the camera. They are of book form, and have automatic closing springs and automatic stop springs to shutters. A folding hood is fitted, which enables a focussing cloth to be dispensed with.



The model H or Pocket Camera occupies, when closed, but with a dark slide in position, for use, a space of $5\frac{3}{4} \times 4\frac{1}{4}$ by $1\frac{1}{4}$ inches. Its portability is, therefore, unchallengeable. The bellows body, when extended for use, is held in position by hinged side wings. The finder is an attachment to the camera, and folds with it, a novel feature in this type of camera. The double dark slides which accompany the camera are made especially thin, but for them may be substituted a pocket automatic changing box, which holds six plates, and is but $1\frac{1}{8}$ inches in thickness.

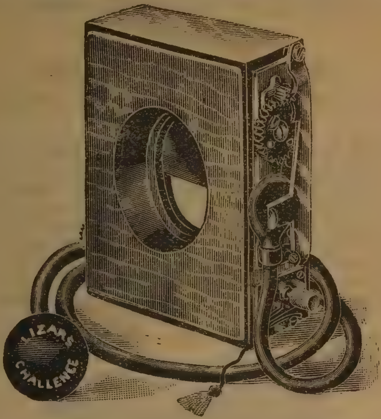




The Challenge Focussing Magazine Stand Camera is of the box form. It carries 12 plates or films, changed by an improved automatic arrangement. The lens is a rapid rectilinear, and is fitted with a Bausch and Lomb shutter, working up to 1-100 of a second, which is set and released from the outside. It is also arranged for time exposures. There are two Brilliant view finders, and, when the camera is not in use, a metal

shield protects the lens from light and dust. A rack and pinion is provided for focussing, and a scale of distances. The sheaths may be inserted in any order, and the number of plates exposed is indicated by an automatic plate register. The camera is fitted with screw bushes for attachment to a tripod.

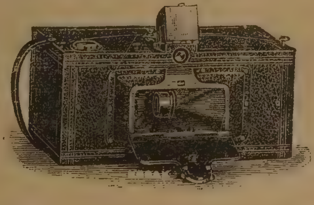
The Challenge Time and Instantaneous Shutter is of the roller blind principle. The speed is variable from 1-15 to 1-90 of a second, the speed being shown by a "speed indicator." The shutter may also be set for time exposures. Two patterns are made, one to fit on the hood or body of the lens, and the other to attach to the camera front; in this case the lens flange is mounted upon a loose panel on the front of the shutter.



THE NO. 4 PANORAM KODAK.

Manufactured and sold by Kodak, Ltd., 43, Clerkenwell-road, E.C.

THIS instrument is similar in construction to the No. 1 Panoram, but it gives a much larger photograph, viz., 12 in. × 3½ in. The camera takes the ordinary bull's-eye spool. It's capacity is five exposures without reloading; the size of the camera, 4¼ in. × 5 in. × 10 in.; weight, 2 lb. 10 oz.; and the length of the focus of the lens, 5 in. In use: when taking the pano-

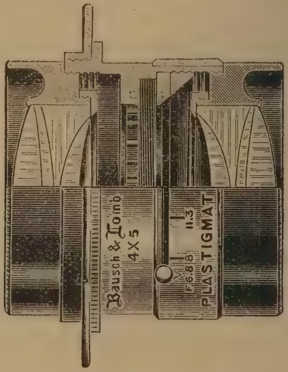


ramic pictures a lever is set, and, on pressing the discharging button, the lens swings round; the film, arranged in a curve at the back of the camera, receives the impression. The view taken includes an angle of 142°. The No. 4 Panoram Kodak has a two-speed shutter, spirit level, a bright finder, and is fitted with socket for tripod screw. V-shaped lines on the top of the camera show the scope of the view. The camera is finished in black morocco leather, with nickel-plated fittings.

THE "PLASTIGMAT" LENS.

Manufactured by Bausch & Lomb. London Agents: A. E. Staley & Co.,
35, Aldermanbury, E.C.

The Plastigmat is a symmetrical lens, the front and back combinations being similar, and composed of four lenses each. The glass is of Jena manufacture, extremely transparent, and absolutely permanent. The use of soft, yellow, tarnishable flint glasses has been avoided, removing all danger of deterioration, and appreciably increasing speed. The separate systems, composed of four lenses each, have the same aplanatic and anastigmatic corrections as the doublet; hence the rear system, when used separately, gives images free from astigmatism and spherical distortion, at a speed of f-13.5, amply rapid for snapshots under normal conditions. The focal length being nearly twice that of the doublet, images twice the size at the same distance are obtained. A new form of mounting has been designed for the Plastigmat. It is very compact and light, and of very neat appearance. Its shortness makes it especially convenient for use on hand cameras. The Iris diaphragm, or Unicum shutter, or other makes of shutters, can be fitted between the lenses.



PRACTICAL NOTES AND SUGGESTIONS OF THE YEAR.

(*Compiled from Various Sources by* The Editor.)

Ammonium Persulphate.

Complaints have occasionally been made concerning the unequal action of the reducer and its liability to cause stains in the films. In the "Chemiker Zeitung," N. Schonchen attributes these faults mostly to insufficient washing of the plate after fixation. As ammonium persulphate is a hypo eliminator and only acts as a reducer in the presence of free sulphuric acid, the following procedure is recommended:—The negative to be reduced should be well washed and then rocked for a few minutes in a dish containing a five per cent. solution of ammonium persulphate made alkaline by addition of a few drops of ammonia. The solution should then be acidified by adding diluted sulphuric acid (1:5) drop by drop, and, when the negative has been sufficiently reduced by the acid solution, it should be rinsed and transferred to a five per cent. solution of sulphite of soda to stop further action. The negative should be finally washed. The editor of the "Photographische Mittheilungen" remarks that he has given the process a fair trial, and has found it very reliable and even in its action.

Ammonium Persulphate.

Professor Namias gives a brief account in Eder's "Jahrbuch" of his researches on the use of the above salt and strongly recommends the following formula:—

Ammonium persulphate	30 grammes.
Alum	50 grammes.
Water	1000 c. c.

The addition of the alum acts as a restrainer upon the solvent power of the persulphate. Namias also combats the idea, advanced by several writers, that the black precipitate formed on the addition of ammonium persulphate to silver nitrate is metallic silver, and states that he has proved it to be a hyposulphate of silver, and further, that a neutral or alkaline solution of ammonium persulphate acts precisely the same as an acid solution, only it is slower. He also suggests that by the use of the ammonium persulphate it is very easy to obtain contretypes, and that it is also a valuable means for correcting over-exposure in carbon printing, and says that it acts by converting the chromic oxide into chromic acid, and incidentally says that it is a good test for chromium. The chemical equation representing the action of the persulphate on the chromic oxide is as follows:—

$$Cr_2O_3+3(NH_4)_2S_2O_8+3H_2O=3(NH_4)_2SO_4+3H_2SO_4+2CrO_3$$

Finally he points out that ammonium persulphate is a far better etching solution than any acid for zinc, copper, and aluminium, and will therefore be useful in photo-mechanical work. When it is to be used for copper the solution should be made alkaline with ammonia. For the reduction of prints, too, he strongly recommends a 0.5 per cent. solution with one or two per cent. ammonia to be used before toning and fixing.

Cellulose Tetracetate.

Professor E. Valenta has made some experiments with this substance, as a substitute of pyroxyline, in the preparation of collodio-chloro-citrate emulsions, and made the following observations upon the subject in the "Photographische Correspondenz." Cellulose tetracetate was prepared in 1894 by Cross and Bevan from cellulose hydrate with a solution of zinc or magnesium acetate, and a patent was obtained for the process. Cellulose tetracetate is easily dissolved in chloroform. A five to ten per cent. solution is rather dark in colour and clears but slowly. It is also soluble in epichlorhydrin, nitrobenzol, and glacial acetic acid. From the latter it may be precipitated by water, or alcohol, in the form of transparent, gelatinous flakes. Although the substance is insoluble in acetone, its solution in chloroform may be diluted with acetone, and some further addition of alcohol may be made without causing precipitation. Such a solution may be used for the preparation of emulsions, and, if suitable precautions are observed, they are easy to coat and yield serviceable printing papers. The experiments indicated that printing paper of very good quality might be made by using cellulose tetracetate, the characteristics being evenness and toughness of film, and a degree of sensitiveness between that of albumen and collodio-chloride. The film is easily permeated by the usual toning and fixing baths. Toning, consequently, proceeds rapidly. The film adheres well to its support, and the gradation of the print resembles that of albumen. The film is likewise very robust, and may be easily spotted by the retoucher. As Professor Valenta has not concluded his experiments, he abstains from giving a formula at present.

Chloride Papers for Development.

L. Hermann Liesegang contributed an interesting paper to the "Photographische Chronik" upon the subject of chloride papers for development. It has special reference to the "Pan" paper, as sold by the well-known firm, E. Liesegang, of Dusseldorf, but the remarks concerning the influence of exposure and strength of the developer are of general interest. The developer used for "Pan" paper is prepared as follows:—

Boiled water	1 litre.
Sodium sulphite	20 grammes.
Hydroquinone	3 grammes.
Carbonate of soda	50 grammes.
Bromide of potassium	2 grammes.

Assuming the negative gives an olive green tone with ten seconds exposure, the following factors of exposure and ratios of dilution for the developer may be used:—

Tone.	Exposure.	Concentration of developer.
Greenish black	1	1 to 5
Olive green	2	1 to 5
Sepia	3	1 to 10
Brown	4	1 to 10
Red brown	6	1 to 20
Yellowish brown	8	1 to 20
Red	5	1 to 30
Reddish	10	1 to 30
Yellow	20	1 to 40

Probably the same interdependence of tone, exposure, and development, may be found with other chloride papers for development now upon the market. The best means to obtain good blue-black is by toning a sepia print with gold.

Chloride of Gold.

The following method of testing chloride of gold was given by H. Reeb, in the "Bulletin de la Société Francaise." One equivalent of chloride of gold is deprived of its colour by four equivalents of hyposulphite of soda; but, in order to determine the reaction more readily, a few drops of saturated solution of iodide of potassium are added to the solution of gold to give it a dark brown colour. Dissolve 1 gramme of the chloride of gold in water, and dilute to 100 c. c. Prepare a fresh solution of hyposulphite of soda (1:1000). Take 1 c. c. of the solution of chloride of gold and add 2 to 3 drops of the saturated solution of iodide of potassium. From a burette add drop by drop sufficient of the solution of hyposulphite of soda to the gold solution to discharge the colour. Read off the quantity of hypo solution used, multiply it by 4 and the product is the percentage of gold contained in the solution of gold chloride. Thus, if 12 c. c. of hypo solution are used, there is 48 per cent. of metallic gold in 100 parts of the gold chloride. Pure brown chloride of gold should contain 64.79 per cent. of gold.

Combined Bath, the.

Dr. E. Vogel, referring to the toning of collodio-chloride prints, remarked, in the "Photographische Mittheilungen," that the presence of acid and alum in the combined bath must cause precipitation of sulphur, and render the permanence of the prints doubtful. The combined process is therefore discredited, although this should not necessarily be the case. He confirms Valenta's statement that prints of considerable permanence may be obtained by using a bath containing hyposulphite of soda, nitrate of lead, and chloride of gold only, if the bath is not overworked. For a litre of toning bath containing 50 c. c. of chloride of gold solution (1:100), not more than eight to ten sheets of paper should be used. It is best then to discard the bath.

Dr. E. Vogel has obtained very good results with the following formula:—

Distilled water	1000 c. c.
Hyposulphite of soda	200 grammes.
Acetate of soda	20 grammes.
Acetate of lead	15 grammes.
Chloride of gold solution (1:100)	50 c. c.

This bath is alkaline, and, as it contains neither acid nor alum, it does not precipitate sulphur. Sulphocyanide of ammonium is purposely omitted, as it has a tendency to double tones, the prints being consequently liable to fade. The bath acts quickly, and violet and blue-black tones are easily obtained. The above quantity is sufficient for eight to ten sheets of collodio-chloride paper. If the prints are washed before toning, the bath will tone evenly, and the small quantity of citric acid present in the paper will be removed.

Drying Negatives

Glass negatives may be quickly dried, free from dust and fly marks, by placing them, film downwards (about three inches apart), in a half-round trough of stout zinc or wood. This can be left out in the open air with safety.

In winter time the drying may be hastened by placing a layer of hot dry sand at the bottom of the trough. It is a good plan to apply a damp chamois leather to the film before placing in the trough.

F. H. Glew.

Electric Lamp, Bichromate.

To make a cheap, simple, and effective bichromate of potash solution lamp, obtain one of the glass jars with screw on lid, which French prunes are sold in. In the centre of the lid cut a 1⅛-inch hole. This will just fit the ordinary incandescent electric lamp holder, and the lid is held in place by the screw shade ring. Half fill the jar with saturated solution of bichromate, and round the upper half of the jar put a band of black paper. Place an 8-c.p. lamp in the holder, and screw on the lid of the jar, so that the lamp is inside. The light from the lamp will thus pass through the solution, and the jar will conveniently stand on a shelf, or hang from a pendant or bracket.

It is well to rub vaseline on the screw of the jar, which will prevent it from sticking, and it can be screwed off in a moment, to have the ordinary light. I work snap-shot isochromatic films 3 feet from the above light with satisfactory results. H. G. M. Conybeare.

Enamelled Ware in Photography.

There is enamelled ware and enamelled ware, for it is not all of the same quality. The dishes and trays, specially made for photography, are of a much better quality than those usually sold at the hardware shops for domestic uses; but are, necessarily, considerably higher in price. However, the ordinary thing is excellent for most photographic purposes, and it has many advantages over the ordinary "porcelain" dishes. It is, as most are aware, iron or low steel, sandwiched between two layers of the enamel, a quiet inert material. But if this surface is imperfect, either from the manufacture or from its receiving injury afterwards so that the metal is exposed, it is manifest that such vessels should not be used for some purposes in photography, such as for containing silver solutions, for example, as then the exposed iron would reduce the silver to the metallic state. They, in this condition, are not suitable for the hypo fixing bath, as the prints, if they rest in contact with the metal might be marked or stained. There are many uses to which these vessels may, however, be put, even though the surface be damaged, in photography. Almost from the first, enamelled ware has been employed for the developer in the platinotype process, and here a slight damage to the glaze is not of importance. For washing prints the common ware of the shops answers as well as the best. In the carbon process it is invaluable, common though it be, for, if there be considerable imperfections in the enamel, it will not in any way interfere with the work. One of the great advantages of this ware is that it will stand heat. Boiling water may be poured direct into it with impunity, or a spirit lamp or gas flame may be put under it without risk, though few would care to risk putting hot water direct into a porcelain dish or putting a spirit lamp beneath it to keep the contents warm. It is for this reason that enamelled ware commends itself so well to carbon and platinotype workers, added to its practicable unbreakability. Though its surface may, by careless treatment, become cracked, which will render it unsuitable for some photographic requirements, it is still usable for others.

Gelatino-chloride Prints, the Development of.

The "Photographische Chronik" reprinted from Eder's "Jahrbuch" Dr. R. E. Liesegang's article upon this subject. As the prints need only receive one-third of the ordinary exposure, the saving in time is very considerable, and the work of the printer in watching the frames is very much reduced. By development the gradation of the print may be controlled, either by reducing or increasing the contrast, and it is thus possible to obtain soft prints from hard negatives, or vice versâ. Tones may be obtained which are otherwise only possible in carbon printing, and they range from the ordinary photographic tone, through red-brown, to olive and greenish-black. If necessary, toning may be dispensed with. Finally, a print produced by development is more permanent than one printed in the customary way. From a study of the tones obtainable by development, it appears that the prints will fix out red if they remain too short a time in the gallic acid bath. By continuing the development the tones will change to brown, and beyond this they will pass to olive and finally to the greenish-black stage. The less red the tone of prints, the less toning will be necessary. Acid development is productive of redder tones than alkaline development, and, as gallic acid with addition of acetate of soda may be rendered alkaline, it is a very desirable developer for black-toned prints. If the prints are intended for prolonged development, they must receive less exposure, and it may here be remarked that the softest prints are obtained by shortest exposure. It is therefore preferable to use vigorous negatives if printing be cut down. It will also be found that contrast is increased by reducing the quantity of developer. Brilliant prints are obtained by using the smallest quantity of solution, whilst further control is secured by using more developer if soft prints are required. Dr. Liesegang prints from a quarter to half ordinary depth, according to the results he wishes to obtain. Four dishes are placed side by side containing an aqueous saturated solution of gallic acid, pure water, a combined toning and fixing solution, and pure water respectively. The solution of gallic acid should be used in a glass or porcelain dish, and it is desirable that the temperature of this bath should not be quite cold. The print should be first immersed in the gallic acid solution, carefully avoiding bubbles, which may be cleared away by drawing the print over the edge of the dish. Leave the print in the developer until it is of full strength, but no longer. Rinse it in the second dish, then transfer it to the third dish containing the toning and fixing bath. If the tone is found satisfactory after the print has been five minutes in the bath, it may be transferred to the fourth dish containing water. If the colour is too red, leave the print for a longer time in the toning and fixing bath. From five to ten prints may be developed in the same bath, but fresh solution must be used as soon as the bath is too black from precipitation of silver. To obtain greenish-black tones add a few drops of saturated solution of acetate of soda to the gallic acid bath. The black specks caused by precipitation of silver upon the prints may be removed after fixation by means of a tuft of cotton-wool; but this is more difficult after the prints have once been dried.

Granularity in Negatives.

Complaint is often made that the coarseness of the particles of silver forming the image makes itself painfully manifest in enlargements. This is generally more noticeable in enlargements from very small negatives than it is in the case of larger ones. For example, given two negatives, one, say, two inches square, and the other the usual quarter-plate size, and both enlarged to the same size, which we will suppose to be twelve by ten inches: the former will appear much coarser than the latter, for the reason that the particles of silver forming the image of the smaller negative are of the same size as those composing that of the larger one, and obviously they are magnified in proportion to the enlargement, and thus become more manifest than if the amplification were less, as in the case of the larger-size picture. Hence lantern slides made from very small negatives appear much more granular when shown on the screen than do those which are taken, say, on quarter-plate negatives. How, then, can this granularity be ameliorated in making enlargements on paper? It may to a great extent be done by making the enlargement with the lens slightly—very slightly—out of focus. This, if judiciously done, will not materially degrade the general sharpness of the picture, though it will subdue the coarseness or granularity to such an extent that it will not be painfully manifested. Professional enlargers are fully cognisant of this fact, and often take full advantage of it. So they do when they have a portrait which has been elaborately, yet coarsely, retouched to deal with. By making the enlargement with the lens very slightly out of focus, a harmonious result is obtained which otherwise would be crude and offensive.

Improved Printing from Plates.

Dr. E. Albert, of Munich, has patented a process for an improvement in printing, of which the following particulars are gathered from the German Patent Specification. A "skeleton" is prepared corresponding to the shadows of the picture, and placed in position upon the back of the plate. Several sheets of paper are then placed upon the surfaces of the plate, and by means of the press a relief is given to those parts representing the shadows. A second "skeleton" is prepared corresponding to the high lights, and placed upon the front of the plate, which is again passed through the press to give an opposite relief to the brighter parts. Zinc has the peculiar property of great ductility at as low a temperature as 100 degrees C., and, upon cooling, will retain the shape then imparted to it. It is thus specially adapted to the process of making ready the surface of a plate for printing, besides being the metal usually employed for photo-mechanical engraving. The object of the process, of course, is to enable the roller to supply more ink to the shadows and less to the high lights. The device is an old one and has been used by engravers, who made the surface of the block or plate of unequal height, according to the light and shade of the picture. This is now done in the "making ready," and it remains to be seen whether the experience of the past, in the printing of engravings, will be found equally correct in photo-mechanical work. We do not see any novelty in the process beyond the fact of taking advantage of the peculiarities of a zinc plate at the comparatively low temperature of 100 degrees C.

Liquid Filters for Dark-room Lanterns.

In a recent number of the JOURNAL a six per cent. solution of bichromate of potash was recommended as a liquid light filter for dark-room lanterns. to which one grain of eosine per ounce is to be added for chromatic plates. The writer has found that this mixture, which is apparently largely used in England, is not so suitable as a solution of mandarin orange. The following tests were made with a lantern made by a wet-plate dipping bath (giving a layer of liquid two centimetres thick) on to a wooden box, the lamp being a small petroleum night lamp of about one-candle power; the plates to be tested were exposed in a plate-holder in a perpendicular position at a distance of forty centimetres, or sixteen inches, and were then developed in the dark.

With the above bichromate mixture a Barnet medium plate was so badly fogged in two minutes that no further tests were made. With a solution of one gramme of mandarin orange in 500 c. c. of water an Ilford chromatic plate and a non-isochromatic film were badly fogged in two minutes, and slightly fogged in thirty seconds. With two grammes in 500 a Barnet medium plate was not fogged in two minutes; an Ilford chromatic plate was decidedly fogged in four minutes, slightly in two minutes, and not at all in thirty seconds. With four grammes in 500 an Ilford chromatic and Barnet medium remained quite free of fog after two minutes' exposure.

The two-gramme solution is quite safe enough for developing either chromatic or ordinary bromide emulsions. It absorbs somewhat more light than the bichromate-eosine mixture, but very much less than ruby glass, so that with this small one-candle-power lamp and an illuminating surface of about 4×5 inches one can perform all the operations of the dark room very conveniently, and can treat the usual isochromatic plate, sensitive to green, like an ordinary plate. Mandarin orange is made by several manufacturers under different names. That used by the writer was from the well-known Gessellschaft fur Anilin Fabrikation in Berlin, and cost, retail, about sixpence for twenty-five grammes. It is called by them Mandarin G extra. W. S. Davenport.

Lost Opportunities.

Some decades ago, when in the popular mind, the slide was not the only dark thing connected with photography, a country woman coming to a market town on the usual annual journey, visited the photographer, and inquired if he made likenesses of children. When he replied that he did, she asked what he charged, and was told, so much a dozen; whereupon she became deeply dejected, and explained that the matter would have to be deferred as she had only eleven.

A few words that smothered a smile prevented a lost opportunity in this instance, but many amateurs who may regard the story as incredible will set out without their cameras because the sun is not shining, or will, for a dozen reasons, carry them for a week without making an exposure, their guiding principle being that it is better to have one good photograph than a hundred that are unsatisfactory.

This self-evident principle that is enunciated by every teacher is, through misapplication, probably in part responsible for the limited number of masterpieces to be found in many collections.

Many celebrated names would be unhonoured to-day if, by numerous trials, repetitions, and experiments, their bearers had not fitted themselves for the hour when the opportunity came to make a bid for fame; and whoever thinks that the noted photographer who exhibits six successful pictures during the year, exposed merely six plates, need only take the evidence that some of the best frankly give to reach a different conviction. A dozen instances could be cited offhand of leading photographs, shown during the past three years, that are acknowledged to have been made only after ten to forty exposures—and this is saying nothing of the batches of ten to forty that were no doubt made upon other subjects, which, in the end, yielded nothing worthy of exhibition.

Photography is an art in which, as much as in any other, constant application is required. A would-be architect who waited in apathy for a dreamed-of time when he should be inspired to design a masterpiece, would have the same chance of realising his dreams as does the camerist who waits for a fixed ideal and conditions before uncapping the lens.

It is only the student who is frequently exposing in various lights, and from many points of view, that is prepared to deal with the subject when the crucial moment arrives. The one who has, meanwhile, lost all opportunities for practising is taken aback at the very instant when he most needs the confidence that comes of experience. If, when the approximately proper direction, stop, and exposure should be as familiar as household words, one must rely upon guessing, and is of the guess again genus, the chances are that every guess will be wrong, and it should not be a surprise that, although the field seemed ripe for garnering the prize, nothing is secured but the record of another lost opportunity.

Some noted pictures are entitled "A rainy day," and it may be taken for granted that many things in the way of experience were saved up in the memory for that day, and that the pictures were not produced without a large amount of preliminary practice on days when most cameras were set aside as useless, practice the immediate tangible results of which were nightmares, but the teachings of which placed it in the category of opportunity well utilised; for there is a lesson to be learned from every exposure and its after treatment, and the true value of the one is better than a hundred. Principle is to be found, not in making only one negative but a hundred, if necessary, to obtain a satisfactory picture.

What is here intended is far from encouragement of the practice of snapping at a hundred different objects with the more or less faint hope that somebody else may later on find in the box one picture that will not seem to make even a dull ruby lamp turn a shade or so darker when it is held before its face for inspection. JAMES REUEL SMITH.

Monochromatic Light Filters.

A concise précis of some notes by Dr. Nagel of Freiburg on this subject, which were given in the "Photographische Chronik," may be useful to three-colour and other workers. An orange filter which only transmits rays between C and D is made by adding to a solution of cupric acetate a few drops of glacial acetic acid, and then drop by drop a concentrated solution of safranine till the solution does not allow any violet, blue, green, or yellow light to pass. A yellow filter can be made by adding to a saturated and slightly acid solution of cupric acetate an acid solution of "orange G" till the brown solution only allows yellow light to pass. A yellowish-green filter is made by acidulating a saturated solution of potassium bichromate with glacial acetic acid, and then adding crystals of cupric acetate, heating the solution and allowing to cool. A green filter is made by adding drop by drop a solution of ammonio-carbonate of copper to a saturated solution of potassium bichromate, till it no longer transmits red light, and then adding a few drops of an alkaline solution of fluorescine. A blue filter is produced by mixing a weak solution of methyl green with a solution of cupric acetate till it no longer transmits red. A violet filter can be made by mixing a concentrated solution of ammonio-oxide of copper with seven parts of water, and combining with it a solution of permanganate of potash, this giving pure violet light between F and G. A red filter can be made by dissolving carmine in carbonate of lithia and adding picric acid solution.

Negatives from Negatives.

Monsieur C. Drouillard read a paper before the Société Francaise de Photographie, in which he described an indirect method of obtaining negatives from negatives by means of permanganate of potash. The negative is copied in the camera by transmitted light, and care is taken that the exposure is not in excess, but, preferably, slightly under. Lumière's diamidophenol is recommended for development in the proportion of ½ gramme to 100 c. c. of a 3 per cent. solution of anhydrous sulphite of soda, and the plate is developed until no further gain of density is obtainable without veiling the high lights, which should remain perfectly clear. Wash the positive quickly in plenty of water for about a minute, and then expose it to diffuse light for seven minutes. Take 60 c. c. of a 10 per cent. solution of permanganate of potash (for a 7½×5 plate), and immediately before use add five to six drops of sulphuric acid. After a second rinsing the plate should be immersed in this solution until the positive completely disappears. Slightly wash the plate, and immerse it in a 1 per cent. solution of anhydrous sulphite of soda. As the colour of the permanganate is discharged the negative will appear, and it may be intensified by development. The second development proceeds much more slowly, and it may be accelerated by using the sulphite solution at double strength, with rather more diamidophenol. A saturated solution of sulphite may be used as accelerator. The density of the negative may be estimated by transmitted light, and when sufficient wash the negative, and put it in the alum bath. Wash again before fixing in hyposulphite of soda. After the sulphite bath, which follows the treatment with permanganate, the washing should not be prolonged, but only sufficient to stop oxidation.

Note on Development.

For some time I have been using, specially for films, the single solution developer recommended for Imperial plates, and compounded thus: metol, 50 gr.; hydroquinone, 40 gr.; bromide of potassium, 25 gr.; sulphite of soda, carbonate of soda, each, 500 grs.; water, boiled or distilled, 20 ozs. It is very convenient, as it does not stain the hands (a great advantage when working films), keeps well, and may be used repeatedly. The only disadvantage I found was, that I had not the control which, when using pyro-ammonia, I secured, by commencing development with half the quantity of ammonia ordered. Recently I have got over this difficulty by making up and keeping a second quantity of developer, containing only half the quantity of carbonate of soda. This I mark No. 1, and use first, finishing with No. 2, containing the full amount of carbonate, should it prove to be required. I have just had striking proof of the advantage of this mode. I made two instantaneous exposures within five minutes of each other, on the same subject, and on plates from same box. No. 1 I developed first with the solution containing half the quantity of carbonate, and finished with the full-strength solution. No. 2 I developed from the first with the full-strength solution. Result: No. 1 was a rattling good negative with plenty of contrast. No. 2, poor, and deficient in contrast. T. Stokoe.

I send a print from each, that Mr. Editor may verify my judgment. (The prints bear out what Mr. Stokoe says of them.)

Panchromatic Sensitiser, A New.

Herr Valenta has been continuing his researches upon the aniline dyes as regards their sensitising action on silver bromide, and in "Photographische Correspondenz" he gives details of a series of dyes obtained from Holliday and Sons, of New York, and amongst these is one called Titan scarlet S, which dissolves readily in water an alcohol with a scarlet-red colour, and a strong solution absorbs the whole of the spectrum from C $\frac{1}{2}$ D to the ultra-violet, and it would therefore be a useful colour-filter for trichromatic work. As a sensitiser, when used for bathing plates in a strength of 1:40,000 with two per cent. of ammonia, with a good exposure an absolutely closed band from B to H is obtained. If to every 100 c. c. of the bath one or two drops of a 1:40 silver nitrate solution be added, the action is much stronger, and from the illustrations given we should say that Valenta is correct in his statement that this is the best sensitiser known to make a panchromatic plate.

Persulphate Reducer, the.

An article in "Das Atelier des Photographen" referred to the uncertainty which is sometimes observable in the use of persulphate of ammonium as a reducer. The salt, like other persulphates, decomposes readily as an acid solution. Oxygen is given off and a sulphate remains. If the solution is alkaline, the oxygen is retained, but as the process of reduction depends upon the conversion of the metallic silver of the image by oxidation to oxide of silver, such a solution is of no use as a reducer. Two rules may be deduced from these facts. Firstly, the ammonium persulphate should not be dissolved until required for use. Secondly, the solution should be tested for acidity with litmus paper, and if the reaction is not distinctly acid, a little sulphuric acid should be added. Another precaution should also be taken. The plate, after reduction, should not be rinsed immediately under the tap, as the oxide of silver is in a very fine state of division and easily converted to metallic silver. The latter will take the form of a bluish precipitate by reflected, but brownish by transmitted light. The plate should be immersed in a solution of sulphite, or hyposulphite of soda. Sulphite is preferable, but, if hyposulphite is used, the solution should not be poured upon the plate. Rapid immersion in a dish is preferable, as the action may otherwise be unequal. For certainty in use, three points must be remembered. Use a fresh solution, see that it is acid, and stop the action of the persulphate by immersion in a suitable bath.

Physiological Effects of the Modern Developer, The.[1]

With regard to the enormous extension of photography, and the consequent enlarged consumption of developers, it is perhaps as well to tabulate experiences as regards the physiological action.

These developers are usually in the form of powders or crystals, which for use are dissolved in water with the addition of an alkaline salt, and these solutions come into contact with the hands and fingers of persons who use them. Naturally, it is rare that the developer, as such, or in solution, gets directly into the stomach, but it may be mentioned that some of the developers must be accounted poisons, particularly pyrogallic acid. It is of more interest to the photographer to hear of the conditions under which alkaline solutions of developers produce harmful effects on the skin in the form of a painful exfoliation, which often takes a long time in healing.

Experience shows that only a few individuals possess this special sensibility to these effects. Further, it is undoubtedly certain that they are as likely to be produced by the alkali in the solution as by the developing substance, and only in one single case, metol, do we know definitely that the reagent produces this inflammation and irritation.

Now there is a great difference in the action of alkalies in the developing solution. Reagents, like amidol, which assert their power of developing with the very weak alkaline reaction of sodium sulphite only, can be considered harmless. Up to the present no case of irritation is traceable to amidol. The unpleasantness first appears with the employment of the carbonic alkalies in the developer, i.e., sodium carbonate and potassium carbonate, and it is, without doubt, those developers which require abundant quantities of these alkalies, such as hydroquinine, that have the most unfortunate results, while those which only require small quantities of these alkalies, such as eikonogen and imogen sulphite, can be classed among the harmless.

With the employment of caustic alkalies the peril is again raised; but here it is as well to understand whether the alkali enters into combination with the developer forming a phenolate, or whether it is contained, as such, in the solution with the reagent.

A characteristic case of the first condition is that of rodinal, in which, as is well known, there is only added such a quantity of a caustic alkali as is just sufficient to conduct the change of paramidophenol $\left(C_6H_4\begin{matrix}OH\\NH_2\end{matrix}\right)$ into the phenolate $\left(C_6H_4\begin{matrix}ONa\\NH_2\end{matrix}\right)$. In this case the corrosive action of the caustic alkali is diminished, and the effect on the skin is reduced to a minimum.

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[1] Translated from the "Mittheilungen der Actien-Gesellschaft für Anilin-fabrikation."

Quite the reverse is the case when the developer is not able to absorb the added caustic alkali by the formation of a new salt, as, for instance, in the case of paraphenylendiamin $\left(C_6H_4\begin{matrix}NH_2\\NH_2\end{matrix}\right)$ metacarbol, and in this case solutions of this kind react as strong alkalies, and possess the same corrosive action as equivalent solutions of caustic alkalies; continual working with such a developer is not possible. DR. M. ANDRESEN.

Platinum Prints, Intensifying and Toning.

In Eder's "Jahrbuch" the following means of modifying platinum prints are given by Raimund Rapp, of Vienna. To intensify a print, wash it thoroughly and immerse it in the following bath:—

Cold saturated solution of gallic acid	50 c. c.
Water	50 c. c.
10 per cent. solution of silver nitrate	2 c. c.
Glacial acetic acid	10 to 20 drops.

The print will intensify slowly, and, when it has acquired sufficient depth, wash it in two or three changes of water to which a little acetic acid has been added. The silver, which has been deposited on the image, is then converted to platinum by using the following bath:—

Water	600 c. c.
Potassium chloro-platinite	1 gramme.
Phosphoric acid	15 c. c.

Wash the print once more.

As the process is based upon physical development, by the introduction of various modifications, other tones may be secured after the print has been treated with the gallic acid and silver bath. For reddish tints use the well-known uranium intensification formula very much diluted. The bath may be reduced to one-tenth of its ordinary strength. Green tones may be obtained by treating a red or brown uranium toned print with a twenty-five per cent. solution of sulphate of iron. If a print toned green in this way is immersed in water acidulated with hydrochloric acid, it will acquire an intense blue tone. Less pronounced green and blue tones may be obtained by immersing the silver intensified print in the following bath:—

Water	50 c. c.
Ferricyanide of potassium solution (1:50)	20 c. c.
Ammonio-citrate of iron solution (1:50)	10 c. c.
Uranium nitrate solution (1:50)	10 c. c.
Glacial acetic acid	10 c. c.

The prints gradually acquire a green tone, but, if the subsequent washing is too prolonged, they turn blue. A very fine deep blue tone may be obtained with the following gold bath:—

Water	1 litre.
Nitrate of lead	15 grammes.
Sulphocyanide of ammonium	40 grammes.

After filtration add:—

Chloride of gold solution (1:50)	20 c. c.

The prints may remain several hours in the bath, during which time intensity of the tone increases. Wash for about an hour.

Platinum Toning.

The "Deutsche Chem. Zeitung" gave the following formula for toning matt chloride papers:—

Water	1000 c. c.
Chrome alum	10 grammes.
Salt	40 grammes.

For use take 50 c. c. of the above solution, and 1 gramme of sodium platinic-chloride in 950 c. c. of water. The bath should have a temperature of 20° C. The tones range from reddish-brown to black. As soon as the prints have reached the desired colour they should be transferred to a bath of water rendered alkaline by the addition of a little ammonia or soda. The fixing bath should also be alkaline.

Polishing Mirrors.

The "Deutsche Photographen Zeitung" contained an article describing the process by which mirrors are silvered. As our contemporary remarks, the process is dependent upon skill rather than formula; but a careful description of the procedure may be of value to those who may wish to try silvering mirrors for themselves. Three stock solutions should be prepared with distilled water: a 10 per cent. solution of silver nitrate, a 10 per cent. solution of caustic potash, and a 10 per cent. solution of grape sugar. The chemicals should be of the purest—the caustic potash, for instance, such as used for analytical purposes, and the grape sugar in small, fine crystals. The dishes, measures, and every other article with which the solutions may come in contact should be most scrupulously cleaned and rinsed with distilled water. The glass to be silvered should be cleaned all over with strongest nitric acid, and well washed in distilled water. Heavy mirrors should be supported in the dish by small blocks of glass placed at each corner, or two strips of glass, ¾ cm. thick, placed under the extreme edges on opposite sides. Small mirrors, watch glasses, etc., should be fastened with sealing-wax to blocks of wood, or corks, so that the fingers may not come in contact with the glass. To prepare the solution for use, take 10 c. c. of the solution of silver nitrate and add ammonia, drop by drop, until the precipitate formed is redissolved; then add 10 c. c. of the solution of caustic potash, and again add ammonia to redissolve any fresh precipitate. 25 c. c. of distilled water should then be added to the clear solution. Pour 10 c. c. of the solution of grape sugar into another measure, but do not add it to the silver solution until required for immediate use. Rinse the mirror once again by spraying distilled water upon it. Pour the solution into the dish, and place the mirror upon the supports, face downwards. The mirror should be left in the bath for about twenty minutes. The solution will at first be of a brownish-black colour, but becomes clear as the silver is deposited. In removing the mirror from the bath be careful not to touch the surface, otherwise it will be imperfect, and the fissures will allow water to pass through by capillary attraction and cause dulness. Carefully rinse the mirror once again with distilled water and set it up to dry. When perfectly dry clean the back and edges, warm it and polish with softest wash-leather and rouge. The mirror should be kept warm whilst being polished. The rouge should not be applied direct, the polishing leather being first rubbed on another clean plate of glass. Polish with a light circular motion, and do not breathe upon the surface to hasten the process. Varnish the mirror with collodion dissolved in amyl acetate and cover the back with black varnish.

Preparation of Developers.

The "Bulletin de la Société de Lorraine" contained a very interesting communication with the signature "R. L." The writer has been in the habit of using the following formula:—

A.

Water	1000 c. c.
Sulphite of soda	15 grammes.
Eikonogen	5 grammes.
Hydroquinone	150 grammes.

B.

Water	1000 c. c.
Carbonate of potash	50 grammes.

For development two dishes are used, one containing 100 c. c. of A, and 5 c. c. of B, and the other 100 c. c. of B and 5 c. c. of A. For want of time, the writer prepared the solutions with cold water, and placed the ingredients of A together in the water. The stock was stored in a clear glass bottle and corked. Eighteen hours after, the solution was found yellowish and degraded and it had lost its power of development. To ascertain the cause the writer arranged a set of experiments. The solutions were prepared firstly, with cold water as before; secondly, with boiled water which had stood to cool, and, thirdly, with boiling water. The solutions were stored for ten days, half of each being placed in yellowish-brown, and half in colourless bottles. The bottles of solution were corked and exposed to light. Both samples prepared with cold water had lost their power of development. Both prepared with cold, boiled water, would only develop the high lights, but both prepared with hot, boiling water, were in excellent condition, developed well, and there was no apparent difference between the samples stored in the two kinds of glass bottles. The writer ascribes the loss of power solely to the presence of air in the water, which caused oxidation. Water absorbs air, which is expelled by boiling, but it is again taken up as the water cools. Gases also are only slightly soluble in saline solutions.

Preventing Camera Shake.

I do not know exactly how others overcome the great liability an extended camera has to shaking, especially so when using a telephoto lens, but I find the best way to be by using two tripods on the same camera, one in front, at the usual place, and one in the rear, at the end of the tailboard. This is one way to do it, and, certainly, the best and surest. However, there is another one, less cumbersome when travelling, and nearly as good, but not quite so. Using a tripod, whose legs fold in two only, I put two legs in front, and one in the rear, and that one in line with the camera; then I have two strips of wood of suitable length which go on either side of the end of tailboard, where they are screwed tight, the other ends being screwed on both sides of the screw which holds the leg where it is folded. When all is ready for exposure, and the camera is seen to be able to shake, some by squeezing, some the two strips of wood between the fingers, it can be made perfectly rigid, provided, however, the exposure is not too prolonged. Hoping the above will prove satisfactory, ALBERT LEVY.

Red-sensitive Collodion Plates.

Dr. E. Valenta reported very favourably, in the "Photographische Correspondenz," upon the value of ethyl-violet, as a colour sensitiser, which was obtained from the Badische Anilin und Sodafabriken, Ludwigshafen-a.-R. Although gelatine emulsions give poor results, collodion plates prepared with it work admirably. The following formula gives perfectly clean, vigorous negatives. 25 c. c. of a filtered alcoholic solution of ethyl-violet (1 : 500) are added to a litre of collodion emulsion. After it has stood some time, filter through cotton-wool and coat the plates. Immerse the plates in a bath containing 2 to 3 grammes of silver nitrate per 1000 c. c. of water, acidified with 3 to 4 c. c. of acetic acid. Leave the plates in the bath until the solution flows off freely without forming tears. Well wash after exposure and develop with glycin,[1] diluting the solution with twelve parts of water. The plates will be found very sensitive, the spectrum band extending from B to L ½ E, rapidly rising at C to a maximum at C 1-5 D. With a suitable red screen very good results may be obtained. A solution of tolanroth, obtainable from Kalle, of Biebrich-a.-R., is recommended as a red filter. This should be used in the proportion of 1 in from 350 to 1000 parts of water, the thickness of the filter being 1 c. At the strength of 1 in 350 it only transmits the red and yellowish-red rays.

Reducing Over-printed Proofs.

One often sees in "Answers to Correspondents" the recommendation of the Editor to destroy such. Now, while there is, apparently, good reason for this advice in the fact that with present methods the result is a print of bad colour or uneven tones, there is no reason why a successful method should not be brought to light. He is a smart printer who never gets an over-printed proof, and, if they can be saved, so much the better. P.O.P. can be reduced with cyanide of potash, Farmer's reducer, or permanganate of potash. If the reduction required is very slight, all three may be successfully used in very weak solution after fixing the prints, but they are warmer in colour after the operation. But, if considerable reduction is required, the above method results in muddy, dead-looking prints. I have found that, if treated after the first washing, and before toning, very much over-printed proofs may be successfully reduced, and the result will be in no way different from properly-printed copies, and involve very little extra work. Take one drachm of Namias' Permanganate Reducer to each ounce of waterX latter to be sufficient to well cover a print. After soaking in clean water, immerse the print (treat one only at a time) in reducer, lifting it out every four or five seconds for examination, for the action is fairly rapid even in this weak solution. The point is to stop the reduction at a stage where the print is still, apparently, too dark, when judged by comparison with a wet print that has been correctly printed. After treatment, they are placed in clean water, and are thereafter washed, toned, and fixed with the batch, as usual. In my hands the prints thus treated are, when finished, in an way distinguishable from those not treated.

H. Hands, Jubbulpore, C. P. E. I.

Resin Fumes a Sensitiser.

In an interesting paper on the Lippmann process by Dr. Neuhauss in the current volume of Eder's "Jahrbuch," a large number of experiments are detailed as to the action of particular dyes as sensitisers for individual parts of the spectrum for Lippmann plates, but at the end of the said article the author, referring to the general sensitiveness, points out how little this is, and, though confirming the statement of Valenta, that a supplementary silver bath does increase the general sensitiveness, he points out that the plates must be used at once, or else they become foggy. Towards the end of last summer Neuhauss tried the experiment of warming the plates, and found when the plates were placed in a zinc box with a wooden cover, with a small gas flame under the box, they increased considerably in sensitiveness when left therein for one night, but that a longer stay also induced fogginess. In order to find out the cause of this Dr. Neuhauss heated the box to 60° C. and observed a strong smell of resin, which, of course, arose from the cover, and when this was replaced by cardboard, and the box again heated, there was no increase in sensitiveness, hence Neuhauss concludes that the vapour of resin is a sensitiser. It will possibly be recalled by some of our readers that about 1892 Lenard and Wolff suggested the use of a preliminary bath of an aqueous solution of turpentine for the same purpose.

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[1] The following appears to be the formula :—Dissolve 25 grammes of sulphite of soda in 40 c. c. of hot water, to which add 10 grammes of glycin. Make the solution very hot and add 50 grammes of carbonate of potash in small quantities at a time. Bromide of potassium acts as a powerful restrainer.

Retouching with a Knife.

In the first place, writes Mr. C. Scherholz, a good knife is necessary, and I know of nothing better than what is called a microscopic dissecting knife. It is best to have two for use—one rather broad towards the point, the other tapering to a point almost as fine as a pen. The broad one can be used to remove large masses, such as objectionable parts in a lady's dress, etc.; while the smaller one is very useful in removing false lights in the eyes, stray hairs protruding from the hair or beard, blemishes in the face, protruding bones in the neck, reducing the size of the hands and wrists, etc. In the next place a proper edge is desirable, because without this it is impossible to use the knife satisfactorily. For this purpose I find that a piece of Arkansas stone answers well. It should be used with a little oil. Care is necessary, however, when sharpening the knife, not to get a saw edge, as it is impossible to effectively use it when this is the case. To obviate this, hold the knife rather flat on the stone while rubbing, bearing rather lightly, and be sure to sharpen both sides as equally as possible. Always rub the parts of the negative on which you wish to use the knife with the retouching medium, because, if this is neglected, you are liable to scrape deeper than is necessary. It is also advisable to test the edge of the knife on some part of the negative, which is not to be printed from. Sometimes, owing to negatives being of a slight yellowish colour, those parts which have been scraped will appear too transparent when varnished. This can be remedied by using a very finely-pointed lead, and going over those parts just lightly enough to fill in where the knife has cut too deep.

Three-colour Work, Collodion Emulsion for.

The introduction of cyanine sensitisers, and of the new specially-measured light filters, to suit the sensitiveness of orthochromatic collodion emulsion, made the application of the latter in three-colour work a matter of important consideration to all photo engravers who are connected with colour work.

It has been a long-felt want to use collodion emulsion for trichromatic purposes—a want justified by the shortcoming of orthochromatised dry plates.

Although they have attained great perfection, it lies in the nature of the gelatine plate to absorb colouring matters too eagerly, and to stain too quickly, which feature results in a shifting and, in many cases, total altering of the absorption bands, which become so very uncertain that the adjustment of light filters to suit such plates becomes a matter of trial and error. Collodion emulsion is not influenced in such a high degree by the sensitising with aniline dyes; the screening effect is less pronounced. Colour filters can, therefore, be measured with greater accuracy.

In the emulsion laboratory of Penrose and Co., in London, direct colour half-tone negatives were taken with exposures not exceeding four minutes for all three plates. The great advantages of such working methods are obvious, and it is to be hoped that the deep-rooted conservatism of British photo engravers will give way, when a process is offered to them which, on the Continent, has been leading for years in all branches of process work. HENRY O. KLEIN.

Trichromatic Work, Filters for.

Dr. Eder recommends as a green filter for trichromatic work, with an erythrosin sensitised plate, a solution of Janus green and auramin, as follows:

Solution of Janus green 1:1000	8 c. c.
Auramin solution 1:2000	14-16 c. c.
Water	100 c. c.

For the red filter he uses

Tolan red 1:4000,

or

Naphthol orange 1:500,

both in a thickness of one centimetre. With regard to this green filter we would point out that absorption of Janus green is confined from about C $\frac{1}{4}$ D to D $\frac{1}{2}$ E, so that it permits the whole of the red and orange from A to C $\frac{1}{4}$ D to pass, whereas naphthol green absorbs the whole of the red. Probably, however, as the plates that should be used with the green filter are not sensitive to red, this may be ignored.

Wellington Film, A Note on the Manipulation of the.

So much has been already written on the subject of the advantages and disadvantages of using films, that it is not necessary to go into the matter here beyond saying that every device that tends to make a film more satisfactory, is gladly welcomed by that large body of photographers, who would only be too delighted to discard plates for a portion or the whole of their work, could they but find a film that really fulfilled their requirements. There can be no two opinions about the advantages of a film of the nature of the Wellington stripping film for enlarged negatives, on account of the ease with which it can be used for silver, carbon, or platinum printing, while the absence of any risk of breakage is a consideration of great importance in large sizes. For the best work, however, it is no use to have a negative containing creases which the most violent springs will not flatten out in the printing-frame, nor does it tend to good temper if the film insists on curling up directly it is released for half a minute, while the advantage of being unbreakable is dearly bought at the price of the negative being spoilt by being accidentally creased by doubling up, or by having a drop of water spilled on it.

The object of this note is to show how all these disadvantages may be overcome with very little trouble. I don't say that it is impossible to avoid creases by following the instructions issued with the Wellington film; but I do say that very frequently creasing of some sort is found even when the utmost care has been taken. Now, this creasing can be entirely avoided if, instead of squeegeeing on to a ferrotype plate, as the makers recommend, the washed films be mounted (paper side down, of course), on very stiff cardboard, in just the same way as a P.O.P. print, and then allowed to dry. When the films are absolutely dry, they can be stripped off without a crease, leaving their paper support still attached to the card. The mounting is as easy as squeegeeing, and as long as the film is allowed to become thoroughly dry before any stripping is attempted, not a crease will be found from corner to corner. Any old piece of very thick card will do, or, possibly, a well-planed wooden board would prove equally serviceable, and the paper backing could be washed off each time ready for another film. I have not, however, actually tried the latter, and do not know whether the ordinary mountants would make the film adhere properly to wood; but I see no reason why they should not. If there is any fear that the mountant has got much over the edge of the film, a print trimmer may be run round just a sixteenth of an inch from the edge before stripping; but with due care this is unnecessary. I have placed several 10×8 films straight from the washing water on a piece of glass one on top of the other, just like P.O.P. prints, and after they were mounted and had got thoroughly dry, I have found no difficulty in stripping them without any cutting. Not only does this method prevent creases, but the films so treated will show little or no tendency to curl, and, if stored under slight pressure, will always lie flat in the printing-frame.

Having described the way to avoid the first two of the three disadvantages mentioned above, let us now consider the third. viz., what to do with a stripped film that has been accidentally creased. Obtain a piece of glass a size larger than the film, for instance, a 10×8 for a whole-plate film, 12×10 for a 10×8 film, etc., and place it in a deep dish about half full of cold water. Take the creased film, and also put it in the water, and wait till it gets limp; then bring it in contact with the glass, and raise both together gently out of the water, keeping the film as near as possible in the centre. The film is so tough that this is easier than it sounds. When the excess of water has drained off, examine the reverse side of the glass to see that no air bells have got in between the film and the glass. If they have, return to the water, and lift out, as before. When the film is satisfactorily arranged on the glass, allow to drain for a short time, blot off the edges, and remove any superfluous moisture, then take a brushful of Page's fish glue, and gently lifting one corner of the film, insert the brush for about a quarter of an inch, and run it down one side between the film and the glass, repeat this on the other three sides, and set the plate up to dry. When quite dry, lift one corner with a sharp knife, when the film may be peeled off without a crease and perfectly flat. The use of the glue is necessary to prevent the film peeling off as it dries, and so becoming worse than it was originally. When I first tried this dodge, I feared the film would expand greatly, and so alter the densities, but I found the increase was trifling, being only about a quarter of an inch each way in the 10×8 size, with which I was experimenting. It is best to place the matt surface of the film next the glass, as the after stripping is then easier. I may add that as little glue as possible should be used for fastening the edges, and that it should be inserted evenly all round.

To sum up:—First, there is no need to get creases at all, except by accident, if the films are in the first place mounted on a stiff support instead of being squeegeed. This is no more trouble, and does away with a ferrotype plate altogether. Second, if a film does not happen to get creased, it can be quickly made once more even and flat by imposing it on glass, and sticking the edges, so that it cannot move till peeled off. The great point about both the manipulations I have described is that the film should not be stripped too soon, and unless it is wanted in a special hurry, it is better in both cases to leave it attached to its support for at least twenty-four hours before stripping.

CLAUDE RIPPON, M.A.

Yellow Stains on Bromide Prints.

Chemical complications may most unexpectedly give a batch of bromide prints a yellow stain—possibly from the formation of sulphide of silver. This may be cleared off as follows:—Acidulate 40 ounces of water with $\frac{1}{2}$-ounce of a ten per cent. solution of sulphuric acid. To this add from one to two ounces of a saturated solution of chloride of sodium (common table salt). Immerse the prints in this, after fixing and thorough washing; watch the result carefully, and in a few minutes the whites will have cleared. Rinse, and replace them in a freshly-mixed acid fixing bath for ten minutes, then thoroughly wash and dry.

J. A. D. LLOYD, Kodaikanal, Madras Presidency.

Zinc Plates, Preparing.

The "Moniteur de la Photographie" quoted from "Le Procédé" the following process of preparing zinc plates for the albumen or bichromated mucilaginous processes. The plate should be carefully polished with polishing felt and tripoli, then rinsed in running water, and whilst still wet, impressed in the following bath:—

Water	1000 c.c.
Alum	50 grammes.
Strong solution of gum arabic	50 c. c.
Nitric acid	20 c. c.
Sulphuric acid	5 c. c.

Rock the dish and keep the plate in the bath two or three minutes. Wash the plate in running water for ten or twelve minutes, and let it dry spontaneously by exposure to air. The badger should not be used, as the slightest friction will spoil the extremely fine grain of the surface thus prepared.

MISCELLANEOUS INFORMATION.

THE LONDON COUNTY COUNCIL'S CARBIDE OF CALCIUM REGULATION.

THE following is an abstract of the Regulations as to the Keeping, Sale, and Conveyance of Carbide of Calcium in the County of London :—

This abstract has no legal validity, and is intended only for the information and guidance of the persons concerned. For further information reference should be made to the Petroleum Acts, and to the Orders in Council dated 20th February, 1897, and 7th July, 1897.

General.

1. By an Order in Council, dated 26th February, 1897, carbide of calcium can only be kept in pursuance of a licence granted by the local authority.

2. By a further Order in Council, dated 7th July, 1897, not exceeding 5 lbs. of carbide may be kept without licence, provided it is kept in separate substantial hermetically-closed metal vessels containing not more than 1 lb. each.

NOTE.—The Order does not provide for the keeping of any quantity except in a closed vessel. Only one vessel should, therefore, be opened at a time, and the quantity of carbide, not exceeding 1 lb., required for use, should be at once placed in the generator, which should be immediately closed. If any carbide remain in the storage vessel, such vessel should be at once re-closed.

3. Where carbide of calcium is—
   (*a*) Kept at any place ; or
   (*b*) Sold or exposed for sale,
   the vessel containing it shall bear a label stating in conspicuous characters, the words, 'Carbide of Calcium,' 'Dangerous if not kept dry,' and with the following caution :—'The contents of this package are liable if brought into contact with moisture to give off a highly inflammable gas,' and also the name and address of the owner or vendor.

Licences.

4. Application to the Council for a licence to keep carbide of calcium at any place in the County of London (except the City of London) must be made upon the form provided for the purpose, which can be obtained by application in writing, addressed to the Chief Officer, Public Control Department of the London County Council, 6, Waterloo-place, S.W.

5. Every application must be accompanied by a fee of 5*s*. in money, or, if sent throgh the post, by cheque or postal order for that amount payable to the order of the London County Council. The fee will be returned to the applicant if the licence be not granted.

6. Every application must state—
   (*a*) The quantity of carbide of calcium which the applicant desires to keep.

(*b*) The proposed place and method of storage;
(*c*) If the carbide is only to be kept for sale in closed vessels, or if it is to be used in the manufacture of acetylene gas.

7. Carbide of calcium should be kept in strong metal vessels, and—
(*a*) Such vessels should be so constructed and closed as to prevent the admission of water or atmospheric moisture.
(*b*) Such vessels should only be opened for the time necessary for the removal of any required quantity of carbide, or for the refilling of the vessels.
(*c*) No one vessel should have a greater capacity than 3696 cubic inches (equal to a cylindrical vessel, 14 inches in diameter and 24 inches in depth).
(*d*) Every vessel of a greater capacity than 2 lbs. should be provided with a lock or be placed in a locked receptacle so as to prevent unauthorised persons gaining access to the contents.
(*e*) Copper should not be used in the construction of vessels for containing carbide.

8. Vessels containing carbide of calcium should not be kept inside dwelling-houses, but preferably in dry and well-ventilated outbuildings.

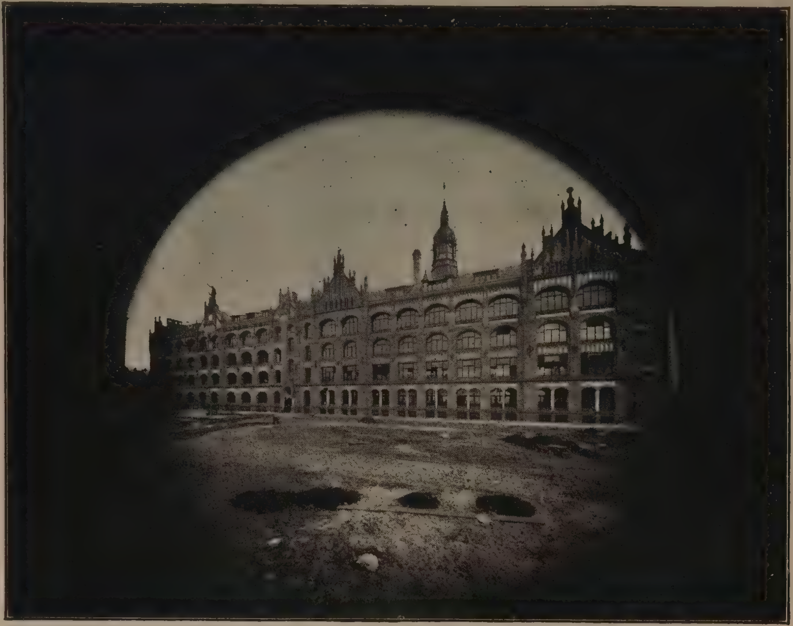
9. Small quantities of carbide for sale or immediate use will, however, be allowed in shops, dwelling or workshops, upon licensed premises, if the arrangements are satisfactory.

10. The Council proposes only to grant licences to keep carbide of calcium which is pure (in a commercial sense), *i.e.*, which contains no impurities liable to generate phosphoretted or siliciuretted hydrogen so as to render the gas evolved liable to ignite spontaneously.

11. Where carbide of calcium is kept for the manufacture of acetylene gas, it is desirable that such of the following precautions for ensuring safety as are applicable to the circumstances, should be adopted—
(*a*) Every apparatus for generating and storing acetylene gas should be placed in an outbuilding. (This does not apply to portable apparatus holding a charge of less than 2 lbs. of carbide).
(*b*) Such building should be separated as far as may be practicable from inhabited buildings, and should be well ventilated.
(*c*) No fire or such artificial light as would ignite inflammable gas should be taken into or near the building or place where a gas-making apparatus is situate.

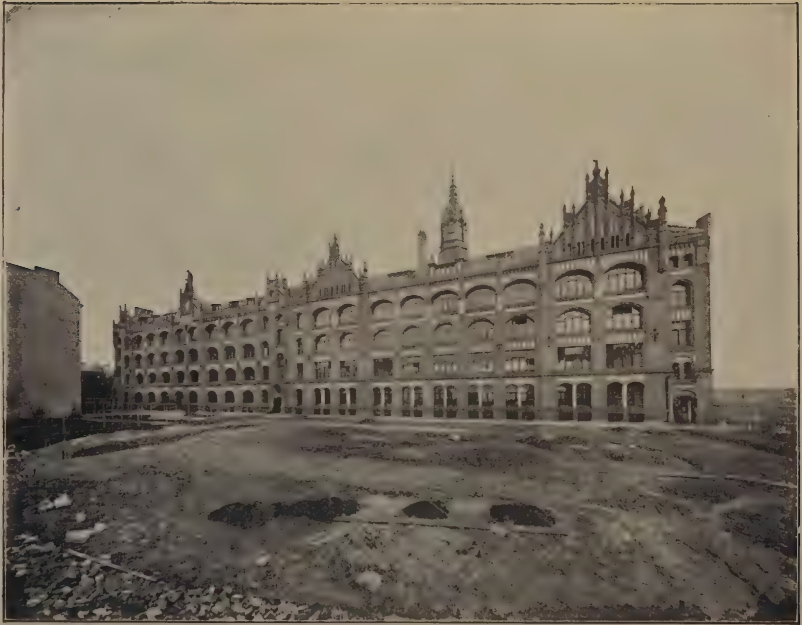
12. Every apparatus (including generator and gas-holder) used for acetylene gas should as far as practicable be constructed and used so as to provide against the special risk, *i.e.*—
(*a*) Copper should not be used in any part of the apparatus.
(*b*) The various parts should be of adequate strength.
(*c*) Escape of gas from the apparatus should be carefully guarded against.
(*d*) Satisfactory provision should be made against dangerous development of heat.
(*e*) Satisfactory provision should be made against undue pressure by the employment of an adequate safety valve connected with a pipe discharging into the open air, and a suitable pressure gauge should be attached to the apparatus.
(*f*) Provision should be made for the residue of the carbide being mixed with at least ten times its bulk of water on being removed from the apparatus.
(*g*) No person should have charge of an apparatus until he has been properly instructed in its management.

13. Licences are granted for keeping carbide of calcium for periods not exceeding one year, and prior to expiration application must be made for



THE GOERZ OPTICAL WORKS, BERLIN-FRIEDENAU.

This photograph was taken on a 12×10 plate with a wide angle anastigmat of 84 mm. ($3\frac{5}{16}$ inches) focus, at *f*. 36. See next page for a similar photograph taken with the new **Goerz Hypergon Double Anastigmat.** (See page 396).



THE GOERZ OPTICAL WORKS, BERLIN-FRIEDENAU.

Photograph, to which reference is made on previous page, taken with the new **Goerz Hypergon Double Anastigmat,** focus 90 mm. (3½ inches), from the same standpoint, on 10 × 12 inch plate at *f*/31. The lens was raised two inches out of centre, demonstrating the enormous angle covered by the lens.

(See page 396).

their renewal. Notice of the expiration, and a form of application for renewal, is sent to each licencee at the proper time.

Conveyance of Carbide of Calcium.

14. Where carbide of calcum is sent or conveyed, the vessel containing it shall bear a label stating in conspicuous characters the words, "Carbide of Calcium," "Dangerous if not kept dry," and with the following caution:—"The contents of this package are liable if brought into contact with moisture to give off a highly inflammable gas," and also the name and address of the sender.

15. Carbide of calcium conveyed to or from licensed premises must be conveyed in accordance with the conditions of the licence.

Inspection.

16. Any dealer who refuses to show to any officer authorised by the Council every or any place or all or any of the vessels in which carbide of calcium in his possession is kept, or to give him such assistance as he may require for examining the same, or to give to such officer samples of such carbide of calcium on payment of the value of such samples, or who wilfully obstructs the Council, or any officer of the Council, in the execution of these Acts and the order made thereunder, is liable to a penalty not exceeding twenty pouuds. ALFRED SPENCER, *Chief Officer.*

6, *Waterloo place, S. W., April* 21, 1899.

THE LONDON COUNTY COUNCIL'S NEW REGULATIONS RESPECTING THE USE OF CINEMATOGRAPH LANTERNS, &c., IN PREMISES LICENSED BY THE COUNCIL.

(Approved by the Council, October 16, 1900.)

1. No cinematograph, or other similar apparatus involving the use of a lengthy combustible film, shall be exhibited on premises licensed by the Council, until the Council has been satisfied that all reasonable precautions have been taken against accident and danger to the public.

2. Notice of any intended exhibition shall be given to the Clerk of the Council by the licensee of the premises in which such exhibition is to be given, and the licensee shall be held entirely responsible for the proper and safe use of the apparatus. Such notice shall be given at least three days before the first day of exhibition. Opportunity shall also be afforded to the Council's inspector of inspecting the apparatus before the public exhibition takes place, in order to allow time for any necessary alterations to be carried out and approved by the Council. No gangway or exit must be in any way affected.

3. The cinematograph shall stand in a suitable fire-proof room or closed sheet-iron box of sufficient dimensions to allow the operators to work freely and fitting closely to the floor, which shall be covered with fire-resisting material within such room or box. The door or doors shall open outwards and be self-closing, and of the three windows which are necessary in the front face of the enclosure, the centre one shall not exceed 8 inches square, and the windows on each side shall not exceed 6 inches square; a flap screen, to cover all these three holes, shall be fitted and actuated both from the inside and from the outside of the enclosure; the space separating the audience and seats from the iron enclosure shall not be less than 2 feet in width at the sides and in the front of the enclosure, and the space at the back in which the door is

situated shall not be less than 6 feet from the enclosure. The audience shall be completely excluded from the above space around the enclosure by a suitable barrier. No unnecessary combustible material shall be within the enclosure, and, as far as possible, all necessary combustible material shall be rendered fire-proof, or shall be enclosed in fire-proof receptacles. The part of the film immediately opposite the lens shall be provided with an apparatus which prevents the film, if kindled, from burning towards either of the spools.

4 The body of the lantern shall be constructed of wood or other non-conducting material, and shall be coated inside with asbestos; it shall also have an inner lining of sheet-iron, and an air space shall be left between the iron and the asbestos lining. In the bottom of the lantern shall stand an iron tray, which shall be surrounded by a vertical edge at least 1 inch in depth. The lantern shall be provided with a metal shutter, which shall fall freely between the source of light and the condenser. This shutter shall be immediately dropped in the event of any accident to the apparatus or stoppage of the film, and shall only be raised when the film is in motion for the purpose of projection.

5. Where possible the electric arc light shall be adopted as an illuminant, the usual rules for securing safety in an electric installation being observed. Ether and other inflammable liquids shall not be employed under any circumstances for producing light. If limelight be used in the lantern the general regulations for its safety, which are issued by the Council, shall be complied with, and any additional precautions which the Council may deem necessary for securing safety shall also be adopted. The use of acetylene gas will not be permitted.

6. The space in which the cinematograph stands shall, where possible, be illuminated by electric glow lamps; but a miner's safety lamp may be substituted, if necessary. No naked gas or oil flames, or matches shall be allowed in the space. The lighting of the hydrogen flame in the lantern shall be accomplished by means of an electric lighter.

7. The films, when not actually passing through the lantern, shall be kept enclosed in metal cases. The film which is passing through the lantern shall be re-wound, either automatically or by hand, upon another bobbin as fast as it emerges from the lantern front.

8. Not less than two, nor more than three, operators shall be engaged within the lantern space, and no other persons shall be within the lantern enclosure during the exhibition. The whole duty of one of the operators shall consist in taking charge of the film after it has passed through the lantern.

9. The licensee shall be held responsible for the employment of competent, experienced and trustworthy operators, and shall be prepared at any time to supply to the Council satisfactory credentials in this respect.

10. Smoking within the lantern space shall be absolutely forbidden at all times.

11. The Council reserves to itself the right of modifying any of the above regulations and of requiring the adoption of any further precautions, in addition to those specified above, as circumstances may require.

THE POISONS ACT.

THE following is a list of poisons scheduled in the Poisons Act.

SCHEDULE A.

Part 1.—Arsenic and its preparations, prussic acid, cyanide of potassium and all metallic cyanides, strychnine and all poisonous vegetable alkaloids and their salts, aconite and its preparations, emetic tartar, corrosive sublimate; cantharides; savin and its oil; ergot of rye and its preparations:

Part 2. Oxalic acid, chloroform, belladonna and its preparations, essential oil of almonds unless deprived of its prussic acid, opium and all preparations of opium or of poppies.

The clauses of the Act which relate to the sale of poisons by unqualified persons are two in number, and are as follows:—

From and after December 31, 1868, any person who shall sell or keep an open shop for the retailing, dispensing, or compounding poisons, or who shall take, use, or exhibit the name or title of chemist and druggist, or chemist or druggist, not being a duly registered pharmaceutical chemist, or chemist and druggist, or who shall take, use, or exhibit the name or title pharmaceutical chemist, pharmaceutist, or pharmacist, not being a pharmaceutical chemist, or shall fail to conform with any regulation as to the keeping or selling of poisons made in pursuance of this Act, or who shall compound any medicines of the British Pharmacopœia except according to the formularies of the said pharmacopœia, shall for every such offence be liable to pay a penalty or sum of 5*l.*, and the same may be sued for, recovered, and dealt with in the manner provided by the Pharmacy Act for the recovery of penalties under the Act; but nothing in this Act contained shall prevent any person from being liable to any other penalty, damages, or punishment to which he would have been subject if this Act had not passed.

It shall be unlawful to sell any poison, either by wholesale or by retail, unless the box, bottle, vessel, wrapper, or cover in which such poison is contained be distinctly labelled with the name of the article and the word poison, and with the name and address of the seller of the poison; and it shall be unlawful to sell any poison of those which are in the first part of Schedule A to this Act, or may hereafter be added thereto under section two of this Act, to any person unknown to the seller, unless introduced by some person known to the seller; and on every sale of any such article the seller shall, before delivery, make or cause to be made, an entry in a book to be kept for that purpose stating, in the form set forth in Schedule F to this Act, the date of the sale, the name and address of the purchaser, the name and quantity of the article sold, and the purpose for which it is stated by the purchaser to be required, to which entry the signature of the purchaser and of the person, if any, who introduced him shall be affixed; and any person selling poison otherwise than is herein provided shall, upon a summary conviction before two justices of the peace in England, or the sheriff in Scotland, be liable to a penalty not exceeding 5*l.* for the first offence, and to a penalty not exceeding 10*l.* for the second or any subsequent offence, and for the purposes of this section the person on whose behalf any sale is made by any apprentice or servant shall be deemed to be the seller: but the provisions of this section, which are solely applicable to poisons in the first part of the Schedule A to this Act, or which require that the label shall contain the name and address of the seller, shall not apply to articles to be exported from Great Britain by wholesale dealers, nor to sales by wholesale to retail dealers in the ordinary course of wholesale dealing, nor shall any of the provisions of this section apply to any medicine supplied by a legally qualified apothecary to his patient, nor apply to any article when forming part of the ingredients of any medicine dispensed by a person registered under this Act; provided such medicine be labelled, in the manner aforesaid, with the name and address of the seller, and the ingredients thereof be entered, with the name of the person to whom it is sold or delivered, in a book to be kept by the seller for that purpose; and nothing in this Act contained shall repeal or affect any of the provisions of an Act of the Session holden in the fourteenth and fifteenth years in the reign of Her present Majesty, intituled *An Act to Regulate the Sale of Arsenic.*

A TABLE OF POISONS AND ANTIDOTES. Compiled by Mr. J. V. Elsden.

	Poisons.	Remarks.	Characteristic Symptoms.	Antidote.
Vegetable Acid.	Oxalic Acid, including Potassium Oxalate	1 drachm is the smallest fatal dose known.	Hot burning sensation in throat and stomach; vomiting, cramps, and numbness.	Chalk, whiting, or magnesia suspended in water. Plaster or mortar can be used in emergency.
Caustic Alkalies.	Ammonia Potash Soda	Vapour of ammonia may cause inflammation of the lungs.	Swelling of tongue, mouth, and fauces; oftened followed by stricture of the œsophagus.	Vinegar and water.
Metallic Salts.	Mercuric Chloride	3 grains the smallest known fatal dose.	Acrid, metallic taste, constriction and burning in throat and stomach, followed by nausea and vomiting.	White and yoke of raw eggs with milk. In emergency, flour paste may be used.
	Acetate of Lead	The sub-acetate is still more poisonous.	Constriction in the throat and at pit of stomach; crampy pains and stiffness of abdomen; blue line round the gums.	Sulphates of soda or magnesia. Emetic of sulphate of zinc.
	Cyanide of Potassium	*a.* Taken internally, 3 grs. fatal.	Insensibility, slow gasping respiration, dilated pupils, and spasmodic closure of the jaws.	No certain remedy: cold affusion over the head and neck most efficacious.
		b Applied to wounds and abrasures of the skin.	Smarting sensation.	Sulphate of iron should be applied immediately.
	Bichromate of Potassium	*a.* Taken internally.	Irritant pain in stomach and vomiting.	Emetics and magnesia, or chalk.
		b. Applied to slight abrasions of the skin.	Produces troublesome sores and ulcers.	
	Nitrate of Silver		Powerful irritant.	Common salt to be given immediately, followed by emetics.
Concentrated Mineral Acids.	Nitric Acid	2 drachms have been fatal. Inhalation of the fumes has also been fatal.	Corrosion of windpipe, and violent inflammation.	Bicarbonate of soda, or carbonate of magnesia or chalk, plaster of the apartment beaten up in water.
	Hydrochloric Acid	½ ounce has caused death.		
	Sulphuric Acid	1 drachm has been fatal.		
	Acetic Acid, concentrated, has as powerful an affect as the mineral acids.			
	Iodine	Variable in its action; 3 grains have been fatal.	Acrid taste, tightness about the throat, vomiting.	Vomiting should be encouraged, and gruel, arrowroot, and starch given freely.
	Ether	When inhaled.	Effects similar to chloroform.	Cold affusion and artificial respiration.
	Pyrogallol	2 grains sufficient to kill a dog.	Resemble phosphorous poisoning.	No certain remedy. Speedy emetic desirable.

INSURANCE COMPANIES AND EXHIBITIONS OF ANIMATED PHOTOGRAPHY.

In view of the increasing number of Exhibitions of animated pictures which are being held, it may be desirable that our readers should know under what conditions Fire Offices allow the use (either temporary or permanent) of cinematographs or similar apparatus. The following have been adopted by Insurance Companies:—

Rules *re* Exhibitions of Animated Pictures.

1. The lantern must be constructed of metal or lined with metal and asbestos.
2. An alum or water bath must be used between the condenser and the film.
3. The apparatus must be fitted with a drop shutter available in case o emergency.
4. If the film does not wind upon a reel or spool immediately after passing through the machine, a metal receptacle with a slot in the metal lid must be provided for receiving it.
5. If electric arc lights are used, the installation must be in accordance with the usual rules, *i.e.*, the choking coils and switch to be securely fixed on incombustible bases, preferably on a brick wall, and d.p. safety fuses to be fitted.
6. If oxyhydrogen gas is used, storage must be in metal cylinders only.
7. The use of an ether saturator is not to be permitted under any circumstances.

Position.—Preferably on an open floor with a space of at least six feet all round railed off. If in a compartment, the compartment to be lined with fire-resisting materials. In any case no drapery or combustible hangings to be within two yards.

General.—Fire buckets to be kept filled, and a damp blanket to be provided and placed close at hand.

FREEZING MIXTURES.

The following mixtures will be found useful where ice is not readily obtainable—

	Ingredients.	Parts by Weight.	The Temperature at starting being 50° Fahr. the thermometer sinks.	Diminution of Temperature.
1	Water Nitrate of ammonia	1 1	From + 50° to + 4°	46° Fahr.
2	Water Saltpetre Chloride of ammonium (sal ammoniac)	16 5 5	,, + 50° ,, + 10°	40° ,,
3	Water Nitrate of ammonia Carbonate of soda	1 1 1	,, + 50° ,, + 7°	43° ,,
4	Snow Chloride of sodium	2 1	,, 32° ,, − 5°	37° ,,
5	Snow Crystallised chloride of calcium	2 3	,, + 32° ,, − 50°	82° ,,
6	Crystallised sulphate of soda Hydrochloric acid	8 5	,, + 50° ,, 0°	50° ,,

COINS AS WEIGHTS AND MEASURES.

1 Sovereign weighs	123·274 grains
1 Shilling ,,	87·273 ,,
48 Pence ,,	1 lb. avoirdupois
Half-penny and three-penny piece weigh	¼ ounce
Florin and sixpence	½ ,,
Three pennies	1 ,,
4 half-crowns and 1 shilling	2 ounces
4 florins, 4 half-crowns, 2 pennies, weigh	4 ,,

1 Half-penny=1 inch in diameter

ENGLISH AND METRICAL SIZES OF PLATES.

English Sizes Converted into Metric Measure.

Inches.			Centimetres.
3¼ × 3¼	(Lantern size)		8·2 × 8·2
4¼ × 3¼	(Quarter-plate)		10 8 × 8·2
5 × 5	(American size)		12·7 × 10·1
6¾ × 3¼	(Stereoscopic)		17·2 × 8·2
6½ × 4¼	(Double quarter)		16·5 × 10·8
6½ × 4¾	(Half-plate)		16·5 × 12·0
7 × 5			17·7 × 12·7
7½ × 5			19·0 × 12·7
8 × 5			20 3 × 12·7
8½ × 6½	(Whole-plate)		21·5 × 16·5
9 × 7			23·0 × 17·7
10 × 8			25·4 × 20·3
12 × 10			30·5 × 25·4
15 × 12			38·0 × 30·5
18 × 16			46·0 × 40·6
20 × 16			50·8 × 40·6
22 × 18			55·9 × 46·0
24 × 20			61·0 × 50·8

Metrical Sizes Converted into English Measures.

Centimetres.	Inches.
9 × 12	$3\frac{9}{16}$ × 4¾
12 × 15	$4\frac{11}{16}$ × 5⅞
13 × 18	5⅛ × 7⅛
18 × 24	7⅛ × 9½
21 × 27	$8\frac{5}{16}$ × $10\frac{11}{16}$
24 × 30	9½ × 11⅞
30 × 40	11⅞ × 15¾
40 × 50	$15\frac{11}{16}$ × $19\frac{11}{16}$

EXHIBITION RULES.

The following rules for the conduct of Photographic Exhibitions have been agreed to by a conference of Judges:—

Rules.

1. The Judges' decision upon the merit of the exhibits shall be final, and they shall not be asked to decide any other point.

2. The Judges shall have full power to withhold any award, and this shall be stated in the prospectus.

3. The Judges shall have power to exclude all persons from the room while judging.

4. The Judges' expenses shall be paid.

5. The Judges shall not adjudicate upon pictures exhibited as produced with wares of special trading firms.

6. No awards shall take the forn of a money prize.

7. Where there is a champion class, pictures which have previously taken awards in OPEN classes shall be exhibited in the champion class only.

8. An award shall be made to one picture only, whether it is in print, lantern slide or other form ; but, in cases where the exhibition rules provide for slides to be exhibited in sets, the award shall be made to the best slide in the best set.

9. There shall be no distinction between amateur and profesional.

10. No production of any kind whatever from the same negative shall receive more than one award, at the same exhibition. This includes lantern slides, enlargments, &c.

11. No award shall be made to a lantern slide until it has been projected on the screen.

12. It shall be stated on the entry form to what extent the work sent for competition is that of the exhibitor.

13. That the names of those who have consented to act as Judges shall be printed in the prospectus of the Exhibition.

RECOMMENDATIONS.

14. Where the Judges make more than one award to the same competitor, all these should be published in the award list, although there be an exhibition regulation debarring a competitor from receiving more than one prize.

15. The Judges should have power to give extra awards where they may think fit.

16. In order to enhance the value of awards their number should be limited.

17. The Exhibition Comittee should not accept offers of awards from trading firms.

18. It is desirable not to have classes. Where there are classes, their number should be kept as small as possible, and divisions where made should be entirely respecting 'subjects,' such as portraiture, landscape, &c, and not such as hand-camera classes, enlargement classes, &c.

The undermentioned Judges have signified their intention of upholding the rules of all future open exhibitions :—

R. Child Bayley,
Thomas Bedding,
J. Bulbeck,
Harold Baker,
F. P. Cembrano,
Lyonel Clark,
Walter L. Colls,
P. H. Emerson,
J. Gale,
John H. Gear,
J. P. Gibson,
John A. Hodges,
Frederick Hollyer,
Payne Jennings,
Fred. C. Lambert,
Paul Lange,
Edgar G. Lee,
Percy Lund,
A. Mackie,
C. H. Oakden,
Andrew Pringle,
James A. Sinclair,
Henry Sturmey,
W. Thomas,
W. Wainwright,
E. J. Wall,
H. Snowden Ward,
Mrs. Catharine Weed Ward,
J. B. B. Wellington.

ON THE RELATIVE POWER OF LANTERN ILLUMINANTS.

M. Molteni gives these as follows. His experiments were made with an ordinary lantern, in the stage of which was inserted a screen with an opening seven cm. square, similar to the marks used in mounting lantern transparencies. The distance of the lantern from the screen was so adjusted that the side of the enlarged image of the square measured one metre. The enlarged image was received on the Bunsen grease spot (commonly used in photometry), the surface of which, remote from the lantern, was illuminated by a lamp carefully standardised by means of a 'Carcel' standard, burning forty-two grammes of oil per hour. The 'Carcel' lamp is the standard of light in general use in France. It is equal to ten English standard sperm candles. The distance of the standard lamp from the screen was adjusted so as to obtain equality of illumination on each side, and the relative intensity of the various lights was calculated from the distances thus obtained. It will, of course, be understood that during the various trials the lantern was not moved from the position necessary to give an enlargement of one metre square. The following are the results obtained:—

Multiple wick oil lamps	1
Welsbach burner (No. 2) without reflector	1
Acetylene—	
1 burner without reflector	1·06
2 burners, without reflectors	1·70
3 ,, ,, ,,	3·20
4 ,, ,, ,,	4·10
5 ,, ,, ,,	4 50
Limelight—	
Oxycalcium (alcohol and oxygen)	5·80
Oxyhydrogen (coal gas and oxygen)	16·60
Oxyether (gasoline and oxygen)	18·50
Electric (continuous current)—	
Ordinary incandescent lamp 32 c p (?)	·68
,, ,, (vertical) 50 c.p. (?)	·93
,, ,, (horizontal) 50 c p. (?)	·43
Focus lamp, 100 c.p.	3·82
Arc lamp, 7 ampères	39·03
,, 10 ,,	75 61
,, 12 ,,	86·50
,, 15 ,,	117 61
,, 20 ,,	160 80

The above results might, of course, have been expressed in terms of the Carcel unit, but the author is of the opinion that the table is likely to be more useful in the form in which an ordinary multiple wick oil lamp is taken as an approximate unit, since every one who has had the merest experience in lantern matters will be able to attach a tangible value to the figures when thus expressed; as, for instance, that the oxyhydrogen light is from sixteen to eighteen times more powerful than the paraffin lamp or an arc light of seven ampères about twice the power of the oxyhydrogen light.

TABLE FOR FINDING THE MINIMUM LENGTH OF STUDIO FOR A GIVEN LENS.

(*From the 'American Amateur Photographer.'*)

DISTANCES IN INCHES FROM OBJECT TO LENS.

Equivalent Focus of Lens. In.	3 in. high.	4 in. high.	5 in. high.	6 in. high.	8 in. high.	10 in. high.	12 in. high.	16 in. high.	20 in. high.	24 in. high.	30 in. high.	36 in. high.	48 in. high.	54 in. high.	60 in. high.	72 in. high.
3	75	57														
4	100	76	$61\frac{3}{5}$	52												
5	125	95	77	65	50											
6	150	114	$92\frac{3}{5}$	78	60	$49\frac{1}{8}$										
8	200	152	$123\frac{1}{5}$	104	80	$65\frac{6}{10}$	56									
10	250	190	154	130	100	82	70	55								
12	300	228	$184\frac{4}{5}$	156	120	$98\frac{3}{5}$	84	66	$55\frac{1}{5}$							
16	400	304	$246\frac{2}{5}$	208	161	$131\frac{1}{5}$	112	88	$72\frac{2}{5}$	64	$54\frac{2}{5}$	48				
20	500	380	308	260	200	164	140	110	$90\frac{3}{4}$	80	68	60	50	$46\frac{2}{3}$		
24	600	456	$369\frac{3}{5}$	312	240	$196\frac{4}{5}$	168	132	$110\frac{2}{5}$	96	$81\frac{3}{5}$	72	60	56	$52\frac{4}{5}$	48
30	750	540	462	390	300	246	210	165	$136\frac{1}{8}$	120	102	90	75	70	65	60
36	900	684	$554\frac{2}{5}$	463	360	$307\frac{1}{5}$	252	198	$165\frac{3}{5}$	144	$122\frac{2}{5}$	108	90	84	$79\frac{1}{6}$	72
48	1200	912	$739\frac{1}{5}$	624	480	$393\frac{1}{5}$	336	264	$220\frac{4}{5}$	192	$163\frac{1}{5}$	144	120	112	$105\frac{3}{5}$	96
60	1500	1080	1024	780	600	492	420	330	$272\frac{1}{4}$	240	204	180	150	140	132	120
72	1800	1368	$1108\frac{4}{5}$	936	720	$614\frac{2}{5}$	504	396	$321\frac{1}{5}$	288	$244\frac{4}{5}$	216	180	168	$158\frac{3}{5}$	144

DISTANCES IN INCHES FROM LENS TO GROUND GLASS.

Equivalent Focus of Lens. In.	3 in. high.	4 in. high.	5 in. high.	6 in. high.	8 in. high.	10 in. high.	12 in. high.	16 in. high.	20 in. high.	24 in. high.	30 in. high.	36 in. high.	48 in. high.	54 in. high.	60 in. high.	72 in. high.
3	$3\frac{1}{8}$	$3\frac{1}{6}$														
4	$4\frac{1}{6}$	$4\frac{3}{9}$	$4\frac{5}{18}$	$4\frac{1}{3}$												
5	$5\frac{5}{24}$	$5\frac{5}{18}$	$5\frac{25}{72}$	$5\frac{5}{12}$	$5\frac{5}{9}$											
6	$6\frac{1}{4}$	$6\frac{1}{3}$	$6\frac{5}{12}$	$6\frac{1}{2}$	$6\frac{2}{3}$	$7\frac{1}{9}$										
8	$8\frac{1}{3}$	$8\frac{4}{9}$	$8\frac{5}{9}$	$8\frac{2}{3}$	$8\frac{8}{9}$	$9\frac{1}{9}$	$9\frac{1}{3}$									
10	$10\frac{5}{12}$	$10\frac{5}{9}$	$10\frac{25}{36}$	$10\frac{5}{6}$	$11\frac{1}{9}$	$11\frac{7}{18}$	$11\frac{1}{2}$	$12\frac{2}{9}$								
12	$12\frac{1}{2}$	$12\frac{2}{3}$	$12\frac{5}{6}$	13	$13\frac{1}{3}$	$13\frac{2}{3}$	14	$14\frac{2}{3}$	$15\frac{1}{3}$							
16	$16\frac{2}{3}$	$16\frac{8}{9}$	$17\frac{1}{9}$	$17\frac{1}{3}$	$17\frac{7}{9}$	$18\frac{2}{9}$	$18\frac{2}{3}$	$19\frac{5}{9}$	$20\frac{1}{6}$	$21\frac{1}{3}$	$22\frac{2}{3}$	24				
20	$20\frac{5}{6}$	$21\frac{1}{9}$	$21\frac{7}{18}$	$21\frac{2}{3}$	$22\frac{3}{9}$	$22\frac{7}{9}$	$23\frac{1}{3}$	$24\frac{4}{9}$	$25\frac{5}{24}$	$26\frac{2}{3}$	$28\frac{1}{3}$	30	$33\frac{1}{3}$	35		
24	25	$25\frac{1}{3}$	$25\frac{2}{3}$	26	$26\frac{2}{3}$	$26\frac{5}{9}$	28	$29\frac{1}{3}$	$30\frac{2}{3}$	32	34	36	40	42	44	48
30	$31\frac{1}{4}$	$31\frac{2}{3}$	$32\frac{1}{12}$	$32\frac{1}{2}$	$33\frac{3}{9}$	$34\frac{1}{6}$	35	$36\frac{2}{3}$	$38\frac{1}{3}$	40	$42\frac{1}{2}$	45	50	$52\frac{1}{2}$	55	60
36	$37\frac{1}{2}$	38	$38\frac{1}{2}$	39	$39\frac{2}{3}$	40	42	44	46	48	51	54	60	63	66	72
48	50	$50\frac{2}{3}$	$51\frac{1}{3}$	52	$53\frac{1}{3}$	$54\frac{2}{3}$	56	$58\frac{2}{3}$	$61\frac{1}{3}$	64	68	72	80	84	88	96
60	$62\frac{1}{2}$	$63\frac{1}{3}$	$64\frac{1}{6}$	65	$66\frac{2}{3}$	$68\frac{1}{3}$	70	$73\frac{1}{3}$	$77\frac{2}{3}$	80	85	90	100	105	110	120
72	75	76	77	78	$79\frac{1}{3}$	80	84	88	92	96	102	108	120	126	132	144

Suppose the lens used is 24 in. equivalent focus, and you wish to make a full-length portrait of a man 6 ft. high, in which the image will be 6 in. high. Look at the left-hand column for lens focus, and in the top line for size of image. At the intersection of these columns we find 312 in. = 26 ft., to be the distance the person must stand from the lens In the next table, using the same lens and size of image as before, at the intersection of the columns we find 26 in., which represents the distance of the ground glass from lens centre. And in the same way any lens and size of image may be computed for.

DARK-ROOM TABLE.

By CHARLES LOUIS HETT.

FOR the reduction of formulæ given in Avoirdupois and Liquid Measure into proportional parts. It is arranged so that any formula for the usual 20 ounces (1 pint) solution will, when converted, give the number of grammes or cubic centimetres in a litre of mixture. When the original formula is for any other quantity, the resulting proportions may still be used for grammes and cubic centimetres; or they may be further calculated to adjust the bulk to 1000 parts. This conversion is shown in part B of the example.

	NUMBER OF	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
WEIGHTS.	Grains	0·34	0·46	0·57	0·68	0·80	0·91	1·03	1·14	1·26	1·37	1·49	1·60	1·71	1·83	1·94	2·06	2·17	29
	Drachms ($27\frac{11}{32}$ grains)	9·38	12·5	15·6	18·8	21·9	25·0	28·1	31·2	34·4	37·5	40·7	43·8	46·9	50·0	53·1	56·3	59·4	62·5
	Ounces ($437\frac{1}{2}$ grains, 16 drachms)	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
MEASURES.	Minims ($\frac{175}{192}$ fluid grains)	0·31	0·42	0·52	0·63	0·73	0·83	0·94	1·04	1·14	1·25	1·35	1·46	1·56	1·67	1·77	1·87	1·98	2·08
	Drachms (60 minims, $54\frac{11}{16}$ fluid grains) ...	18·7	25·0	31·3	37·5	43·7	50·0	56·3	62·5	68·7	75·0	81·2	87·5	93·7	100	106	113	119	125
	Ounces (480 minims, 8 drachms)............	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000

APPLICATION OF THE TABLE.

IN the following example the third column shows the simple conversion by the table into proportional parts. The fourth gives the same, adjusted to 1000 parts of water.

TONING AND FIXING BATH.

	1. Materials.	2. As commonly given.	3. Proportional parts converted by table.	4. Last column multiplied by $\frac{20}{4} = 5$
A	Sodium tungstate	180 grs.	20·6 say 20	—
	Ammonium sulphocyanide ...	300 grs.	34	—
	Hypo	6 ozs.	300	—
	Water	20 ozs.	1000	—
B	Gold chloride	15 grs.	1·71	8·55 say 9
	Water	4 ozs.	200·	1000

When in use, the quantity of gold constantly varies. Therefore 10 per 1000 = 1 per cent. may be used. A tube contains 1 gramme of gold chloride, and only requires to be dissolved in 100 c. c. of water.

For developing, use 100 c. c. conical graduated glass. A 500 c. c. measure is a convenience in making up solutions, but is by no means essential. Foreign medicinal water bottles contain 1 litre (1000 grammes or cubic centimetres) and are useful for solutions.

CHARACTERISTIC REACTIONS OF THE KNOWN DEVELOPING AGENTS.

[Translated from the *Photographische Correspondenz.*]

By DR. M. ANDRESEN.

THE number of the developing substances used in photography has so considerably increased in the last decade that a summary of the characteristic reactions of these substances will be useful to the practical worker. The tabular statement will render it easy for any expert to recognise any developer which may be introduced into the market under a fancy name.

It is advisable to make the investigation in a systematic manner. The substances must be tested in a given order of reactions, so that it will be easier and more certain to determine what developing substances may be present, and then to determine by special tests what is the actual substance.

The procedure is somewhat different, according to whether the substance is in the solid or liquid form.

A. THE SUBSTANCE IS A SOLID.

A small quantity, about 1 gramme, should be finely powdered and dissolved in 100 c. c. of cold water.

(*a*) The substance will not dissolve. Test for glycin and di-amido-oxyphenol.

1. It dissolves on the addition of some solid sodium sulphite and carbonate of potash = glycin. Test the solubility of the original substance in water on the addition of hydrochloric acid (soluble) and of acetic acid (insoluble), and whether the solution, acidulated with dilute sulphuric acid, gives off the smell of quinone on oxidation with potassium bichromate (1 : 15).

2. The substance does not dissolve on addition of sodium sulphite and potash = di-amido-oxyphenol. The original substance should be soluble in water in the presence of acetic acid, so that no quinone is formed on oxidation.

(*b*) A clear solution is formed. In this case all the other developing agents must be tested for.

Add to the one per cent. aqueous solution five per cent. of dry sodium sulphite and ten per cent. of potassium carbonate.

1. If a fine crystalline powder separates out = para-amidophenol. This should be confirmed by the special reactions.

2. The solution remains clear, but becomes coloured; it may be amidol, eikonogen, tri-amidophenol, pyrogallol, or di-amido-resorcin.

(*a*) If the colour is blue = amidol. Test further.

(*b*) The colour is golden yellow and does not alter on standing exposed to the air = eikonogen. Test further.

(*c*) Colour greenish, especially when shaken in a half filled bottle, and turns brown on adding a few drops of caustic soda = tri-amidophenol. Test further with ferric chloride.

(*d*) The solution is brown, which increases on shaking in the air = pyrogallol or di-amido-resorcin. Add a few drops of caustic soda.

(*aa*) The brown colour remains and quickly increases = pyrogallol. Test further by special reactions.

(*bb*) The brown colour turns blue = di-amido-resorcin.

3. The solution remains clear and bright, without any colour—brenzcatechine, hydroquinone, metol, ortol, para-amidophenol (when very dilute), or para-phenyl-endiamine. Test the original substance as to the evolution of quinone by oxidation with potassium bichromate and sulphuric.

(*a*) If no quinone is formed = brenzcatechine. Test with ferric chloride and lead acetate.

(*b*) If quinone is formed by oxidation = hydroquinone, metol, ortol, para-amidophenol, para-phenyl-endiamine.

Add to the aqueous solution of the substance some dilute sulphuric acid and shake with ether.

(*aa*) If on the evaporation of the ether a residue of long needles is left = hydroquinone or ortol. Test for the same. If the hydroquinone comes from the ortol, the original substance will give, on oxidation, the Bordeaux red colour mentioned in the table.

(*bb*) There is no residue, or but little, after evaporation of the ether = metol, para-amidophenol, or para-phenyl-endiamine. Prepare a 1 : 20

solution of the substance, add some dilute sulphuric acid, and cool the solution by the addition of ice, and then add, with stirring, as much concentrated nitrite solution to make it smell of nitrous acid.

(*aa*) If a felted mass of fine needles, separates = metol. Test according to table.

(*bb*) If there is no separation = para-amidophenol or para-phenylendiamine. To some of the clear solution, containing nitrite, add some solution of *α*-naphthol-*ε*-disulphonic acid (known also as Andresen's acid), made alkaline with caustic alkali.

1. The azo dye formed is of a ponceau red shade = para-amidophenol.
2. The azo dye formed is of a Bordeaux red colour = para-phenylendiamine.

B. THE DEVELOPER TO BE TESTED IS AN AQUEOUS SOLUTION.

As aqueous solutions of developing agents generally possess keeping properties only in the presence of sulphites, these will be found in all liquid developers. In order to test this, it is only necessary to acidulate a small quantity of the solution with dilute sulphuric, and the smell of sulphurous acid will prove the presence of sulphite.

To recognise the developing agent, place a small quantity of the original solution in a little dish, and add a little concentrated caustic soda lye.

(*A*) If the solution assumes gradually an intense colour on exposure to the air.

(*a*) If the colour is an intense blue = di-amido-resorcin, a small quantity of the original solution should be acidulated with dilute sulphuric acid, and the solution boiled to drive off the sulphurous acid, a couple of drops of ferric chloride solution, and strongly diluted with water. The solution will then assume the characteristic colour given in the table.

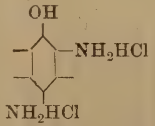
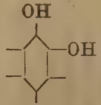
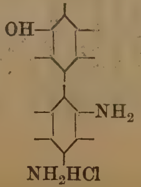
(*b*) The solution, when in contact with the air, quickly turns brown = pyrogallol, amidol, or tri-amidophenol. A small quantity of the original solution should be placed in a dish, and a lot of dry carbonate of potash added.

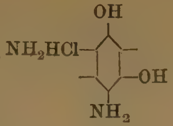
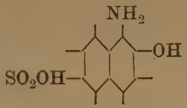
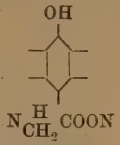
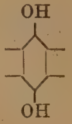
1. The solution turns blue = amidol. Test further as with diamido-resorcin, or extract some of the original sulphite solution with ether, evaporate the latter, and dissolve the residue with water. Ferric chloride gives a red colour.
2. The solution turns brown on exposure to the air = pyrogallol. In order to confirm this, acidulate a small quantity of the original solution with hydrochloric acid extract with ether, dissolve the residue after evaporation of the ether in water, and test as suggested in the table with oxidised sulphate of iron.
3. The solution turns a smutty green = tri-amidophenol. In this case the original solution is more yellow than the former. Test further with ferric chloride as suggested for di-amido-resorcin.

(*b*) Soda lye produces no marked change of colour = brenzcatechine, di-amido-oxyphenol, eikonogen, glycin, hydroquinone, metol, ortol, para-amidophenol, para-phenyl-endiamine.

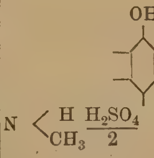
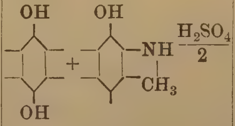
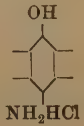
Add to some of the original solution some hydrochloric acid, slowly and with constant stirring, and note if any separation takes place, and then note if the precipitate dissolves in excess of acid.

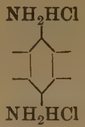
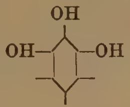
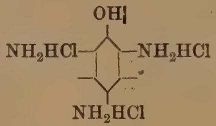
REACTIONS OF DEVELOPING SUBSTANCES.

Commercial Name.	Scientific Name	Constitution Formula.	Crystalline Form.	Melting Point of the Compound.	Solubility.	Behaviour to Acids.
Amidol.	Hydrochlorate of 2·4 di-amido-phenol.		Colourless needles.	Decomposes on heating without melting.	Easily soluble in water. Sol. in alcohol and ether with difficulty.	Precipitated from aqueous solution by conc. hydrochloric acid.
Brenzcatechine or Pyrocatechine.	1·2 Dioxybenzol.		Broad flakes (from benzol). Prismatic needles (from water).	104°	Readily soluble in water, alcohol, and ether; soluble in cold benzol.	—
Di-amido-oxydi-phenal or Diphenal.	Di-amido-oxyphenol.		From water in long felted needles.	148°	Readily soluble in alcohol, glacial acetic acid, and hot water; with difficulty in benzol; almost insoluble in cold water.	Soluble in dilute acids; for instance, acetic.

DI-AMIDO-RESORCIN.	Hydrochlorate of 4·6 Di-amido-resorcin.		Rhombic tables.	Decomposed by heat without melting.	Very soluble in water; sol. with difficulty in alcohol and ether.	Very readily ppt. by conc. HCl from aqueous sol.
EIKONOGEN.	Sodium salt of α_1-amido-β_1-naphthol-β_3-sulphonic acid.		Rhombic plates.	Loses at 110° 2½ molecules of water of crystallisation. On further heating, decomposes without melting.	Easily soluble in hot water; less soluble in cold; almost insoluble in alcohol and ether.	Acids precipitate the free acid in fine white needles from aqueous solution of eikonogen.
GLYCIN.	p-oxyphenyl-glycin.		Mica-like plates.	Melts with decomposition.	V. s. sol. in water and alcohol, insol. in ether.	Forms with mineral acids salts sol. in water, but not with acetic acid.
HYDROQUINONE.	1·4 dioxy-benzol.		Needles, or long hexagonal plates.	169°	Easily sol. in alcohol, ether, and hot water, less sol. in cold, sol. in cold benzol.	—

REACTIONS OF DEVELOPING SUBSTANCES—*Continued.*

COMMERCIAL NAME.	SCIENTIFIC NAME.	CONSTITUTION FORMULA.	CRYSTALLINE FORM.	MELTING POINT OF THE COMPOUND.	SOLUBILITY.	BEHAVIOUR TO ACIDS.
METOL.	Sulphate of the methyl, p. amidophenol.		Needles or prisms. The free base crystallises in long needles.	Decomposes without melting. The free base melts at 87° C.	V. sol. in water, s. sol. alcohol and ether. The free base v. sol. in alc., ether, and hot water, less sol. in cold.	—
ORTOL.	Sulphate of methyl-o-amidophenol + hydroquinone (a mixture).		Sulphate of methyl of amidophenol crystallises in flat rhombic tables or prisms.	Sulphate of methyl of amidophenol decomposes on heating without melting. The free base melts at 80° with decomposition.	V. sol. in water, partial sol. in alcohol and ether (hydroquinone dissolves).	—
PARA-AMIDO-PHENOL.	Hydrochlorate of 1·4 amido-phenol.		Prisms. The free base crystallises in plates.	Decomposed on heating without melting. The free base melts with decomposition at 184°.	V. sol. in water, s. sol. in alcohol and ether. The free base is v. sol. in hot, s. sol. in cold water, fairly sol. in alcohol, s. sol. in ether.	Precipitated from aqueous sol. by conc. hydrochloric acid.

PARA-PHENYLENDIAMINE.	Hydrochlorate of 1·4 phenyl-diamine.		Triclinic tablets. The free base crystallises from ether in tablets. From water monoclinic crystals are obtained which are converted in the water into rhombic plates.	Decomposed without melting. The free base melts at 140°.	V. sol. in water. S. sol. in alcohol. M. sol. in ether. The free base is v. sol. in alcohol and ether, less sol. in water.	Ppt. by conc. hydrochloric acid from the aqueous solution.
PYROGALLOL.	1·2·3-Tri-oxy-benzol.		Colourless shining needles.	Melts at 132·5°.	V. sol. in water, alcohol, and ether.	—
TRI-AMIDO-PHENOL.	Hydrochlorate of 2·4·6 tri-amidophenol.		Needles.	Decomposed without melting.	V. sol. in water, almost insol. in alcohol and ether.	Conc. hydrochloric acid ppt. the compound from aqueous solution.

REACTIONS OF DEVELOPING SUBSTANCES—*Continued.*

COMMERCIAL NAME.	BEHAVIOUR TO ALKALIES.	BEHAVIOUR TO OXIDISING SUBSTANCES.	USED AS A DEVELOPER IN CONJUNCTION WITH—	REMARKS.
AMIDOL.	Sulphite solutions on addition of potassium carbonate turn blue, with caustic potash a Bordeaux red colour.	Ferric chloride produces an intense red colour in aqueous solution. Amidol does not give quinone on oxidation.	Neutral sodium sulphite; alkalies.	—
BRENZCATECHINE or PYROCATECHINE.	Cannot be separated from an aqueous sol. by shaking with ether in the presence of caustic alkalies. After acidulation of the sol. is taken up by the ether.	An aqueous solution gives an emerald green colour with a drop of ferric chloride; without the addition of carb. soda, turns violet red. Gives no quinone.	Alkaline carbonates.	Solution of lead acetate causes a white ppt. with aqueous solution of pyrocatechine.
DI-AMIDO-OXYDI-PHENAL or DIPHENAL.	Not soluble with sulphite or alkaline carbonates, requires caustic alkalies.	Gives no quinone on oxidation.	Caustic alkalies.	The diazo compound of di-amido-oxyphenol gives, with Andresen's α-naphthol-disulphonic acid a ponceau red dye (compare para-amido-phenol).

DI-AMIDO-RESORCIN.	Aqueous sulphite sol. give with pot. carb. a yellow brown; with caustic alkalies, a blue colour.	One drop of ferric chloride sol. gives, in dilute di-amido-resorcin sol., an intense violet colour, which after a short time disappears. No quinone formed.	Neutral, alkaline, sulphites.	—
EIKONOGEN.	Alkaline solutions have a golden yellow colour.	No quinone on oxidation.	Neutral sulphites with alkaline carbonates.	—
GLYCIN.	Is converted by sodium sulphite, carbonate, and caustic alkalies into salts, which are readily soluble in water.	Gives chinone when oxidised with pot. bichrom. and sulphuric acid, with evolution of CO_2.	Caustic alkalies and carbonates.	—
HYDROQUINONE.	Not separated from alkaline aqueous sol. by agitation with ether; is removed, however, after acidifying.	Is easily converted by oxidising agents into quinone. A convenient oxidising sol. is made by dissolving 1 part of conc. sulphuric acid and 1 part of pot. bichrom. in 20 parts of water.	Caustic alkalies and carbonates.	Quinone is recognised by its pungent smell, which is readily given off on heating to boiling aqueous solutions.

REACTIONS OF DEVELOPING SUBSTANCES—*Continued.*

COMMERCIAL NAME.	BEHAVIOUR TO ALKALIES.	BEHAVIOUR TO OXIDISING SUBSTANCES.	USED AS A DEVELOPER IN CONJUNCTION WITH—	REMARKS.
METOL.	Aqueous solutions of metol, which also contain a large proportion of neutral sulphites or alkaline carbonates, contain the metol in the form of the free base.	Gives quinone on oxidation. Metol is, therefore, a phenol derivative, and not a cresol derivative, as is frequently assumed.	Alkaline carbonates.	If an aqueous sol. of metol be acidulated with dilute sulphuric acid, and some nitrite sol. added, the nitroso compound of metol $\left(\mathrm{C_6H_4{}^{OH}_{NCH_3}NO}\right)$ separates out in fine felted needles. Ethereal sol. of the metol base on evaporation leaves the metol in the form of an oily liquid, which sets, on standing, into long rosette-shaped crystals.
ORTOL.	—	Gives, on oxidation with bichromate and sulphuric acid, a deep Bordeaux red colour, and also quinone.	Alkaline carbonates.	—
PARA-AMIDO-PHENOL.	Alkaline sulphites and carbonates ppt. the free base from concentrated aqueous solution; caustic alkalies also ppt. the free base, which is again dissolved on further addition with the formation of phenolate.	Oxidation easily produces quinone. On the addition of chloride of lime sol. to a sol. para-amidophenol mixed with hydrochloric acid, a deep violet colour is first formed, and, on further addition, yellow flocks of chloranide quinone separate.	Caustic carbonates and alkalies.	If a solution of hydrochlorate of para-amidophenol be acidulated with hydrochloric or sulphuric acid, and some nitrite solution added till the smell of nitrous acid is recognised, a diazo compound is formed in the solution which, with Andresen's α-naphthol disulphonic acid, gives, in caustic alkaline solutions, a ponceau red dye.

Para-phenyl-endiamine.	Separated by ether and also from alkaline caustic solutions.	Gives quinone on oxidation. Chloride of lime sol. produces, in a sol. acidulated with hydrochloric acid, quinone dichlordiamide, which separates in yellow flocks.	Caustic alkalies.	The diazo compound of para-phenyl-endiamine gives with Andresen's α-naphthol-disulphonic acid a red-violet colour (compare para-amido-phenol). The shade of this dye is best determined by pouring some of the sol. on filtering paper, and dropping dilute acetic acid on the place.
Pyrogallol.	Sulpho-pyrogallol solutions become brown on addition of a few drops of caustic soda. Pyro is separated by ether from sulphite sol., but not from sulphite and potash solutions.	Gives no quinone.	Alkali carbonates and ammonia.	If a dilute solution of pyro is mixed with a concentrated solution of ferrous sulphate which has become superficially oxidised, there is formed after a short time a beautiful blue colour.
Tri-amido-phenol.	A sulphite sol. is yellowish. By addition of potash the colour becomes green, by adding caustic alkalies it becomes brown. The colours are very distinct if filtering paper be saturated with the solutions and exposed to the air.	One drop ferric chloride sol. produces a dilute aqueous sol. a deep blue colour. No quinone formed.	Neutral alkaline sulphites.	—

(*a*) If a white precipitate is formed = di-amido-oxyphenol, eikonogen, glycin, para-amidophenol.

1. The precipitate formed does not dissolve in excess of hydrochloric acid = eikonogen.

2. The precipitate dissolves on addition of more hydrochloric acid = di-amido-oxyphenol, glycin, and para-amidophenol.

(*aa*) The precipitate does not dissolve on addition of strong acetic acid = glycin.

(*bb*) The precipitate dissolves in excess of acetic acid = para-amidophenol, di-amido-oxyphenol.

Acidulate a small quantity of the original solution with dilute sulphuric acid, drive off the free sulphuric acid by boiling, and add to the boiling hot solution some potassium bichromate.

(*cc*) The solution smells of quinone = para-amidophenol.

(*dd*) There is no smell of quinone = di-amido-oxyphenol.

(*B*) No precipitate is formed on the addition of hydrochloric acid to the original solution = brenzcatechine, hydroquinone, metol, ortol, or para-phenyl-endiamine.

Acidulate a small quantity of the original solution with hydrochloric acid, and shake with ether.

1. If a precipitate is left on evaporation of the ether = brenzcatechine, hydroquinone, ortol.

The residue gives quinone = hydroquinone or ortol. Acidulate a small quantity of the original solution with sulphuric acid, boil off the free sulphurous acid, and oxidise with potassium bichromate. If the red colour mentioned in the table appears, it is ortol; in the other case, hydroquinone.

(*b*) The residue gives quinone = brenzcatechine. Test with ferric chloride and acetate of lead.

2. If there is no marked residue on evaporation on the ether = metol or para-phenyl-endiamine. Acidulate a small quantity of the original solution with dilute sulphuric acid, boil off the free sulphurous acid, and add to the liquid cooled with ice some solution of nitrite till it smells of nitrous acid.

(*a*) If, after the addition of the nitrite, a compound separates out (nitros-metol) = metol. This is proved by no colour being formed in a caustic alkaline solution with α-naphthol-ε-disulphonic acid.

(*b*) The solution containing nitrite gives, when poured into a caustic alkaline solution of α-naphthol-ε-disulphonic acid, a red-violet colour = para-phenyl-endiamine.

In the above notes the method of analysis is given when only one developing agent is present in the secret preparation. It is rather more trouble when two or more reducing agents are present; still the data in the table will be of some assistance, and they may be tested for separately.

THE ADVANCE OF PHOTOGRAPHY AS AN INDUSTRY.

A VERY interesting side-light was thrown upon the art of photography by a writer in the "Photographische Chronik," who showed from official statistics the rapid advance it has made in Germany as an industry during the period of 1875 to 1895. Similar statistics for this country would, perhaps, be more surprising still. In 1875 there were 2506 establishments in Germany, based exclusively upon photography, and they gave employment to 4674 persons. In 1895 these figures had grown to 4589 establishments, giving employment to 11,901 persons, and the following classification may be made:—

2108	businesses,	employing	2108 persons.
91	,,	with motors employing	91 ,,
977	,,	each employing 2 persons	1954 ,,
1031	,,	,, 3 to 5 ,,	3747 ,,
295	,,	,, 6 ,, 10 ,,	2171 ,,
60	,,	,, 11 ,, 20 ,,	824 ,,
22	,,	,, 21 ,, 50 ,,	621 ,,
4	,,	,, 51 ,, 100 ,,	275 ,,
1	,,	....	110 ,,

These figures include photo-mechanical workers. In Germany, as in this country, the population is attracted to the large towns, and we find that Berlin takes the lead in this growth of photography, as shown by the following table:—

NUMBER OF PERSONS ENGAGED IN PHOTOGRAPHIC WORK.

Year.	In Berlin.			In all Germany.		
	Male.	Female.	Total.	Male.	Female.	Total.
1875	342	39	372	4,229	445	4,674
1882	514	89	603	5,681	610	6,291
1895	956	191	1,147	10,412	1,489	11,901

These figures disclose an important fact to which the "Chronik" did not give special attention. We refer to the relatively much larger number of women employed in 1895 as compared with 1875, and more especially in Berlin. It would be interesting to trace this fact to its causes. In 1875 the percentage of women was 9·52 for all Germany, whilst in 1895 it was 12·51. But in Berlin the percentage had grown from 10·48 in the year 1875 to 16·65 in 1895. Is the struggle for existence in Berlin keener than it was, or are the conditions more favourable to the employment of women in photography?

GEOLOGICAL PHOTOGRAPHS.

THIS Committee was appointed by the British Association for the Advancement of Science in 1889, for the purpose of arranging for the collection, preservation, and systematic registration of photographs of geological interest in the United Kingdom.

Since its formation the Committee has been successful in obtaining a number of photographs, of which 2000 were received and registered up to the month of

August, 1898, when the ninth report was presented at the Bristol meeting o. the British Association.

The collection cannot yet be regarded as in any sense complete, for many districts are still poorly represented in it. A great effort is being made to fill up the numerous lacunæ.

The Committee would, therefore, urge upon geologists and photographers the desirability of further assisting the scheme, with the object of completing a national collection of photographs to illustrate the geology of our own country.

The collection has been deposited at the Museum of Practical Geology, 28 Jermyn Street, London, where it is accessible to the public for purposes of reference.

It is desired to obtain photographs illustrative of characteristic rock exposures, especially those of a typical character or temporary nature; important boulders; localities affected by denudation, or where marked physiographical changes are or have been in operation; landslips; raised beeches; old sea-cliffs and other conspicuous instances of marine erosion; characteristic river valleys or escarpments, and the like; types of rock-structure, jointing, folding, and faulting; glacial phenomena, such as *roches moutonnées*, moraines, drums, and eskers; or any natural views of geological interest. Photographs of microscopical sections and typical hand specimens of rocks and fossils are also admissible.

It is important that copies of photographs which have been processed for illustrating articles and papers in journals should be deposited in the collection; they should be accompanied by an exact reference to the publication, and, if possible, a copy of the plate.

Duplicate collections of about 200 prints and about 100 slides have been formed, and the Secretary will gladly forward either or both of them to any local society that contemplates joining in the work, or wishes to see what has already been done.

APPARATUS FOR GEOLOGICAL PHOTOGRAPHY.

The Committee has had under consideration the question of the most suitable form of camera for geological field work. The following is a *précis* of communications from experts who have been invited to offer suggestions on the subject:—

The *best camera* to use is probably that to which the worker is himself most accustomed. These hints are added for those who have not yet adopted any particular camera.

The camera should be as light as possible, but *rigidity* when set up is absolutely necessary.

Double swing-back and rising and falling front are essential, to allow of correct perspective and the true rendering of lines and curves.

The camera should admit of long extension to permit the use of lenses of various *foci*.

It is sometimes desirable to take photographs of inclined or horizontal rock-surfaces at distances of a few feet, for the purpose of showing minor features, such as veins, glacial markings, structures of gneissose rocks, &c. To effect this, two boards hinged together with some arrangement for fixing them at the desired angle are all that is required. The lower board must, of course, be screwed to the stand and the upper one to the camera.

A spirit level should be used with the camera or attached to it.

It is well to have three lenses: (1) A rapid rectilinear doublet of 10 to 12-inch focus (for half-plate size); (2) a wide-angle meniscus, focal length about 6 to 7 inches, for interiors of quarries and craters; and (3) a long-focus lens of focal length equal to three or four times the length of the plate, for distant hills and inaccessible cliffs.

If only one lens is used, it should be a rapid rectilinear of about 9 inch focal length (for half-plate size), and should be by some reputable maker. It must be the best of its kind obtainable. Though films materially decrease the weight to be carried, they are not recommended for general use; plates should be used whenever possible. Good general work can be done with a quarter-plate or 5 × 4 camera, and subsequent enlargement on bromide paper. In this case it is essential that the lens should be of first-rate make, and be used with a small stop. For direct printing, the cold-bath platinotype method is recommended as the most permanent, and it is now very easy to work.

It is advisable, when measurements are unattainable, that a "scale object" should be included in the photograph. (A hammer is sometimes used, but it is not suitable; a walking-stick or a human figure seems to be satisfactory.)

RECOMMENDATIONS FOR THE COLLECTION OF GEOLOGICAL PHOTOGRAPHS.

(1) Societies are urged to form small committees for the purpose of noting sections suitable to be photographed, and arranging such work as may be possible in each district. To this end it is anticipated that the services of many amateur photographers may be secured.

(2) Size of photograph recommended, 8½ × 6½ inches ("whole-plate"); but this is *optional*. In view of the difficulty of carrying a heavy camera and plates, it is not desired to exclude smaller views when these are well defined and clear. In the case of small negatives, when sharp, an enlargement to whole-plate size is desirable. The views should be printed by a permanent process whenever practicable. Isochromatic plates are strongly recommended.

(3) In order to preserve its scientific value, each photograph should be accompanied by *as many* of the following details *as can be conveniently given.* Forms for this purpose will be supplied on application.

(*a*) Name and position of section or locality.

(*b*) Special features shown, with illustrative diagrams when necessary. (Further details may be given, if more convenient, on a separate tracing.)

(*c*) Height and length of section, and compass direction. If possible, a scale of some kind should always be given.

(*d*) Name and address of photographer, or of the society under whose direction the view is taken.

(*e*) Date when photographed.

(*f*) Indication of direction of light and shade; *i.e.*, state whether taken in "direct light" or "in shade."

(4) Each photograph sent in for registration should bear a *local* number, and the accompanying form should be numbered at the top right-hand corner in accordance therewith.

(5) Photographs should be sent *unmounted.* This is essential in order to secure the proper geographical arrangement of the collection. They will be mounted by the Committee on cards of uniform size, with perforated edges for binding, to hold one whole-plate, two half-plate, or four quarter-plate views.

(6) Copies of photographic prints, lists of photographs, and information relative thereto, should be sent under cover to the Secretary of the Committee, at the earliest possible date, in order to facilitate the work of registration. They should be sent in *not later than August* 1 in each year.

(7) It adds very much to the usefulness of the collection when amateurs are willing to place their negatives, or copies of them, in the hands of a professional photographer, with instructions to supply prints or lantern slides, at a price, to those who apply for them. The Secretary would willingly help in giving advice on this point, as he is frequently asked where copies of the contributed prints can be obtained.

Detailed lists of photographs officially received are published in the annual reports of the Committee, which also states where the photographs may be obtained. These reports are published in the "Annual Report" of the British Association, and a copy will be forwarded to the donor of each photograph.

Further information may be obtained from the members of the Committee, or from the Secretary, W. W. Watts, Mason University College, Birmingham, to whom communications should be addressed.

[*Reduced Copy of* FORM **A.**]

FORM A. | Loca No.

BRITISH ASSOCIATION COMMITTEE ON GEOLOGICAL PHOTOGRAPHS.

County. | Photographed under the direction of

Name and position of Locality or Section.

Special features shown.

Details of Section.	Height.	Compass Direction. Camera Pointing.	"In shade" or "direct light."
	Length.		Time: a.m. p.m.

Sketch, or other particulars, if necessary, may be given here :—

Name of Photographer. | Registered No.

Address. Date photographed.

* This number should also be placed on the back of the Photograph.

NOTE.—Copies of the above Form will be supplied on application to the Secretary, to enable the Donors of Photographs to insert the requisite particulars.

RULES OF THE PROFESSIONAL PHOTOGRAPHERS' ASSOCIATION.

(Founded March 28, 1901.)

1. The Association shall be called "The Professional Photographers' Association."

2. The objects of the Association shall be: (*a*) To promote the interests of its members in their professional work. (*b*) To watch Parliamentary or public action affecting the interests of Photographers. (*c*) To deal with matters affecting professional custom and practice. (*d*) To co-operate with similar associations for the purpose of securing united action and mutual support in dealing with matters affecting the profession.

3. Membership shall be restricted to persons engaged in the commercial production of photographs, who shall be either in business on their own account, or in partnership, or responsible managers of firms or companies.

4. Professional photographers may be admitted to membership on the nomination of a member, or on their own application; the Committee shall decide any question as to eligibility.

5. The annual subscription shall be 5*s.* payable on admission, subsequent subscriptions shall be payable in advance on July 1 in each year. No member shall be entitled to any of the privileges of membership if his subscription shall be three months in arrear, and the Committee shall have power to terminate the membership of any one whose subscription is more than six months in arrear.

6. The ordinary meetings of the Association shall be devoted to the discussion of matters concerning the welfare of professional photographers and the profession only; they shall be held on the first Fridays in February, April, June, October, and December. The Committee may call extraordinary meetings when they may think it advisable.

7. All General meetings shall be held in the first week in July, for the purpose of receiving the report of the Committee and the balance-sheet for the past year, the election of Officers, and such other business as may require the decision of a general meeting. Notice of the meeting, together with a ballot paper, shall be sent to every member not less than fourteen days before the date of the meeting. A Special General meeting may be called by the Committee at any time. A special general meeting shall be called within fourteen days of the receipt by the Hon. Secretary of a requisition signed by ten members stating the purpose of the meeting. Every member shall receive seven days' notice of a special general meeting, and no subject shall be discussed thereat but that for which the meeting was called.

8. Alterations of the rules shall only be made at the general meetings or a special general meeting. The alterations proposed shall be stated in the notice convening the meeting.

9. At all meetings the vote shall be taken by show of hands unless a ballot be demanded.

10. The Honorary Officers of the Association constituting the Committee shall be a President, Vice-President, Treasurer, Secretary, and twenty ordinary members of the Committee, not more than ten of whom shall be London members. They shall have power to appoint an Assistant Secretary, who may be paid. At meetings of the Committee, five shall form a quorum.

11. The Committee may make such by-laws and regulations, not inconsistent with the rules, as they may from time to time think necessary. They shall also have power to appoint sub committees for special objects from the members of the Association.

12. The Officers shall retire annually, but shall be eligible for re-election. At a special meeting of the Committee, to be held in the month of May, the

Committee shall select by ballot a President, a Vice-President, and twenty-two other members for the new Committee as their nomination. Any member, by letter addressed to the Hon. Secretary not later than May 31, may nominate a President, Vice-President, and not more than twenty-two other members. The Hon. Secretary shall write to each member nominated to any office, asking whether he is willing to serve if elected, and no reply within four days shall be taken to signify acquiescence. A ballot paper shall be prepared containing the names of all the members nominated, and eligible and willing to serve, in alphabetical order, but no other information except that relating to the taking of the ballot. The ballot papers shall be collected at the Annual General Meeting at nine o'clock.

13. At their first meeting the new Committee shall elect a Treasurer from amongst those elected on the Committee. They may appoint any member as Hon. Secretary, notwithstanding such appointment may increase the number of ordinary members of Committee by one. Should any Officer resign, or become incapable of acting, the Committee may fill the vacancy.

14. If ten members shall sign a report to the effect that they consider it desirable that the membership of any member shall be terminated, on account of conduct either tending to bring discredit on the profession or obnoxious to his fellow-members, the Committee on receipt thereof shall call a special general meeting to discuss the matter; then if a majority of two-thirds of those present so decide, the offending member shall be expelled.

15. Proper books of account shall be kept by the Treasurer, and a book of minutes of all meetings shall be kept by the Hon. Secretary.

16. The payment of a subscription by a member shall be taken as indicating acquiescence in these rules.

ON THE MAKING OF LANTERN SLIDES BY CONTACT AND REDUCTION.

THIS was the title of a paper read before the Sutton Photographic Society, and which was illustrated by the actual making of slides, as well as by showing a number of slides on the screen.

In the production of lantern slides several things have to be taken into account, and I may conveniently divide the subject as follows :—

1. The character of the negative.
2. Making slides by Contact.
3. Making slides by Reduction. (*a*) Using daylight. (*b*) Using artificial light.
4. Development of slides.
5. Clouds or skies in slides.
6. Toning, or otherwise altering the colour of the image.

1. CHOICE OF NEGATIVE.

First, then, in selecting a negative, it has to be considered whether it is suitable for contact or reduction, because, although a pretty bit may be selected from a large negative, and although a quarter plate may often furnish a good slide, yet, unless the idea of ultimately using these negatives for making slides occurred to the person taking them at the time he or she took them, the chances are that something will be sacrificed; moreover, a square picture, such as is thus obtained, is not generally to be recommended. Secondly, there is the really good negative, which will give a satisfactory result with any process, but in addition there may be a *dense* negative or a *thin* negative, and likewise a *hard* negative, which, generally speaking, does not produce a pleasing slide.

2. SLIDES BY CONTACT.

Slides by contact may be made either by daylight or artificial light; but, as they are probably mostly made by amateurs in the evening, I shall only refer to the artificial light method. In the case of the *dense* negative, referred to above, printing the slides should be made close to the light, while the *thin* negative should be printed at a distance, and I may say that it is better to increase the distance than to alter the light or time of exposure. But, when very warm-coloured slides are required, both light and distance may be altered, the developer being of a suitable character. As with negative plates, so with lantern plates, the product of various makers differs considerably, and with the same maker we often have the rapid and slow series of plates, the former generally giving us the black tones, the latter the warm tones. The advice I give here is to stick to one make of plates, and, as far as possible, one developer, following the instructions given by the maker whose plates you have selected. There are practically *no bad plates* on the market, they would have no chance.

Although it is customary to enter in an exposure book all details of the exposure of a negative, yet the practice of doing the same in the case of bromide print or lantern slide is not nearly so common as it ought to be, and yet it would really be even more useful, as the conditions are more fixed than they are in negative-making. I would therefore recommend that notes be made of each exposure saying whether by contact or reduction, light used, distance from light, time of exposure plate used, and what developer, not only as a guide to future operations, but as enabling the operator to at any time obtain an exact replica. In reductions these memoranda could be made on the white side of the mask at the bottom, the name of the slide being at the top.

3. SLIDES BY REDUCTION.

Slides by reduction, of course, have to be made in the camera, or by some piece of apparatus made for the purpose; and here I may say that either enlargement or reduction may be made by the same apparatus if the position of the lens can be altered. I possess a little arrangement made by myself, suitable far quarter-plate negatives, and usable for either daylight or by artificial light; in the latter case I use a condenser, made by Hughes, *i.e.*, one 4¼ × 3¼, being therefore rectangular, and cut from a six-inch circular condenser. This is very convenient.

DAYLIGHT.

(*a*) Using daylight.—Have your apparatus so that it will take a half-plate negative, with a carrier for a quarter-plate *fixed* on one end of a board (of course a larger size may be used if desired), with a camera at the other end of the board, which should be *movable*, and have a rack-work adjustment for the lens, which may be a four-inch one, so that the baseboard may not be unnecessarily long, and stopped down to *f*-16. The negative having been put in its place, film side towards the lens, and the lantern plate in the camera, the apparatus may either be pointed directly to a clear sky, with no houses or trees intervening, or it may be kept flat with a reflector of white paper or opal glass, placed at an angle of 45° with the negative. In either case, see that the illumination is even all over, and that the image is sharp and of the *right size*, which should have been previously marked on the ground glass of the camera. It should be borne in mind that the size of the picture in a slide by reduction, from whatever size negative made, is 3⅓ × 2¼, which is just a *little* larger than the opening in the mask. The exposure may then be made, but it is difficult to give an exact time for this; I may, however, say as a guide, that I have found from 20 secs. to 1 min., lens at *f*-16, according to the character of the negative and time of day and year, avoiding direct sunlight, about right. A piece of fine ground glass may be interposed between the light and the negative, and this would render about double or treble the exposure necessary In any case give *enough* exposure.

ARTIFICIAL LIGHT.

(*b*) Using artificial light.—If a condenser is going to be used, nothing better than the apparatus I have shown you can be desired, but, if the lime light is employed, the exposure is so short that risk of over-exposure is incurred, and it is therefore better to interpose ground glass, as already referred to. I show you two slides, with and without the ground glass; one had 3 secs., the other 6 secs.; and you will see there is not much difference between them. Everybody, however, cannot use the lime light, so a paraffin oil lamp, with a parabolic reflector behind it, about nine inches from the condenser, so as to get an even illumination, will answer the purpose; but, of course, the exposure will be longer. If, however, a condenser is not available, then place a piece of fine ground glass about three inches behind the negative, and either have a paraffin lamp, with a reflector behind it, on each side of the ground glass, or pass a piece of burning magnesium ribbon to and fro, to illuminate the negative evenly, and give a fairly long exposure. Either of these two latter methods should be tried on the ground glass *camera screen* before putting in the lantern plate. As before stated, let the exposure be ample, but not excessive.

4. DEVELOPMENT.

The exposure, by whatever method, having been made, the next process is to develop the plate, and, in choosing the developer, four things have to be borne in mind, *i e.*:—

(*a.*) The kind of plate used.
(*b.*) What the exposure has been.
(*c.*) The colour required.
(*d.*) Whether the slide is to be shown by oil or lime light.

(*a.*) Many makers send out two kinds of plates, fast and slow; the fast are, perhaps, most suitable for exposures made by gaslight and for black tones; the slow for exposures by daylight, either by contact or reduction, for magnesium ribbon, for the lime light, and for the production of warm colours.

(*b.*) The longer the exposure, and a suitable developer, the warmer the colour of the slide.

(*c.*) Suiting both exposure and development, any colour from black to bright red may be obtained.

(*d.*) A slide to be shown by oil lamp must be of a less density than one to be shown by lime light.

Bearing these facts in mind, then, I may state that for lantern slides the development should not require forcing; if it does, an indifferent slide is sure to result. What is wanted is a clean, crisp, surface image, which on projection gives a brilliant picture, with all details, not a hard black-and-white, or a fogged or veiled one. If black tones are required, nothing better than metol or hydroquinone, or a mixture of these two, together with eikonogen or amidol, can be employed. Most excellent results are obtainable with pyro on Thomas and Cadett plates, using their formulæ. I give you two very useful formulæ for black tones:—

1.

A.	Metol	50 grains.
	Hydroquinone	25 ,,
	Sodium sulphite	1 ounce.
	Potassium bromide	20 grains.
	Distilled water to	20 ounces.
B.	Sodium carbonate	2 ounces.
	Distilled water	20 ,,

2.

A.	Hydroquinone	120	grains.
	Sodium sulphite	1¼	ounces.
	Citric acid	30	grains.
	Potassium bromide	30	,,
	Distilled water to	10	ounces.
B.	Sodium hydrate	120	grains.
	Distilled water to	10	ounces.

To make a normal developer, take equal parts of either A or B, and the development should be complete in from two to three minutes. With either of these formulæ the temperature of the developer should be from 60° to 65° F., because at low temperatures hydroquinone almost ceases to act.

Should, however, warm tones be wished for, quite a different procedure is necessary. The exposure has to be prolonged from two to six times the amount required for black tones, and the developer modified accordingly. Thus, supposing 30 seconds at 1 foot from a gas flame, or 1 inch of magnesium ribbon burnt at 3 feet, be suitable (as it is) for the above black tones, then for

Brown tones,	60 seconds	at 1 foot,	or 2 inches magnesium	at 3 feet.
Purple brown,	90 ,,	,, 1 ,,	3 ,,	,, 3 ,,
Purple,	3 minutes	,, 1 ,,	3 ,,	,, 2 ,,
Red,	5 ,,	,, 1 ,,	5 ,,	,, 2 ,,

would be the correct exposure, using Paget plates. The developer necessary is made as follows:—

1.

Hydroquinone	¼	ounce.
Citric acid	1	drachm.
Potassium bromide	30	grains.
Distilled water to	10	ounces.

2.

Sodium hydrate	¼	ounce.
Sodium sulphite	1¼	,,
Distilled water to	10	ounces.

3.

Ammonium bromide	½	ounce.
Ammonium carbonate	½	,,
Distilled water to	10	ounces.

All these solutions keep well, and are used in the following proportions for the different exposures:—

		Time to develop.
Brown tones:		
No. 1, ¼ oz.; No. 2, ¼ oz.; N.o 3, 50 mins.	Water to 1 ounce.	5 minutes, about.
Purple brown:		
No. 1, ¼ oz.; No. 2, ¼ oz.; No. 3, 100 mins.		10 ,, ,,
Purple:		
No. 1, ¼ oz.; No. 2, ¼ oz.; No. 3, 125 mins.		12 ,, ,,
Red:		
No. 1, ¼ oz.; No. 2, ¼ oz.; No. 3, 150 mins.		15 ,, ,,

I will show you results by each of these formulæ on the screen presently. If Thomas plates, however, are used, the exposure has to be much greater; *i.e.*, for brown, 2 inches of magnesium at one foot; purple, 3 inches at one foot; red, 6 inches at one foot. The same solutions as given above may, however, with a little variation (easily calculated) be employed, *e.g.*, for red tones, six inches of magnesium at one foot, and two drachms each of Nos. 1, 2, and 3. There is a peculiarity, too, about Thomas plates. I said above that the image should be a clear, crisp, surface one, but with these particular plates this remark does not hold, because the image seems sunk and indistinct, and density can only be judged by looking through it in front of a good yellow light, but it comes out all right in the fixing. The acid fixing bath will be found useful, as it acts as a clearer as well as a fixer. There are five points to remember in making these warm colour slides :—

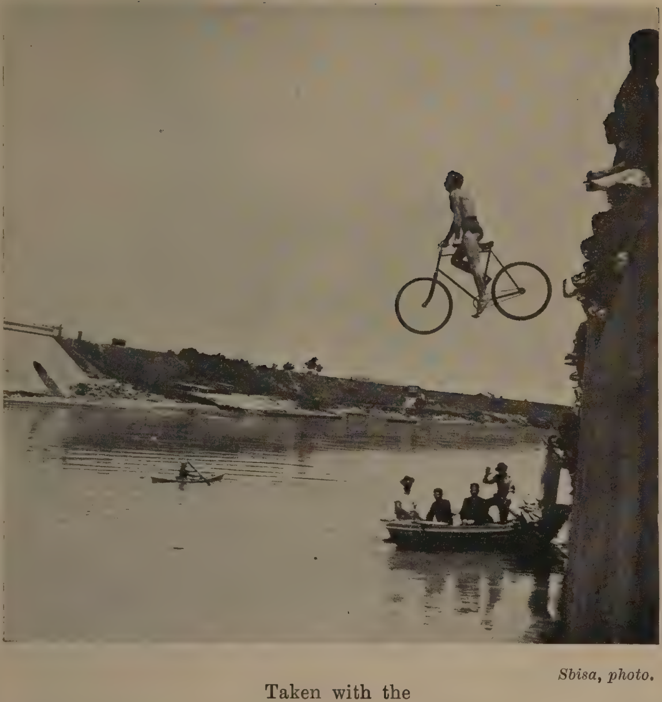
1. The developer must be at 60° to 65° temperature.
2. The *warmer* the colour, the *denser* the deposit.
3. Warm colours lose more in fixing than cold ones.
4. In judging density for projection, especially with an oil lantern, attention must be paid to 2.
5. In case of over-density or slight veil, a judicious application of Howard Farmer's reducer is useful.

I have not referred to the Ilford Alpha plates, because time is limited, but, with these, colours are easily got without all the formulæ given above, and they yield brilliant slides, but they are very slow, and most suitable for contact work by artificial light, though magnesium ribbon greatly diminishes the time of exposure.

5. CLOUDS.

I now come to the last division but one of my subject, and an important one it is, too. We can all remember the time when it was common to show a slide having a vast expanse of bare glass to represent the sky. This was not only very inartistic, but it dazzled the eyes and prevented them from having a proper appreciation of the picture below it. Latterly, however, matters have altered, and we see comparatively few of such slides. The first thing to do, obviously, is to make a good collection of cloud negatives, and suitable clouds may often be seen, especially in spring and autumn. Very strongly-marked or storm clouds may, of course, be taken, and are very suitable for some subjects, especially seascapes ; but, as a rule, it is inadvisable to have obtrusive clouds, because they are, after all, but adjuncts to the picture rather than the picture itself, and should not distract the eye. In taking clouds it is well to use a fairly rapid plate, a small stop, and a quick exposure, and not to develop too deeply (hydroquinone yields very good, clear cloud negatives). But the most important point of all is to note at what time of the year and day the negative was taken, and also to what part of the sky (as indicated by a pocket compass) the camera was directed. These data should be permanently fixed on each negative. It may not be out of place to state that films, perhaps, yield better cloud negatives than plates, and, at any rate, I have got more natural clouds in views with films than with plates. Be this, however, as it may, films possess this advantage, that they may be printed from either side, and so prevent reversal of the clouds. This reversal applies to the contact method ; by copying in the camera, *i.e.*, reduction, it is avoided by taking the sky slide *through* the glass of the sky negative. Clouds obtained, as suggested by Mr. Clayden, by means of the black mirror (*reflected* clouds), are excellent. These, too, can be printed direct without reversal. If then the negative is devoid of natural clouds, it becomes necessary to print these in by some method or other, and there are three ways of doing this :—

1. Printing the clouds on to the slide itself.
2. Printing the clouds on to the cover glass.
3. As No. 2, using the slide itself as a mask.



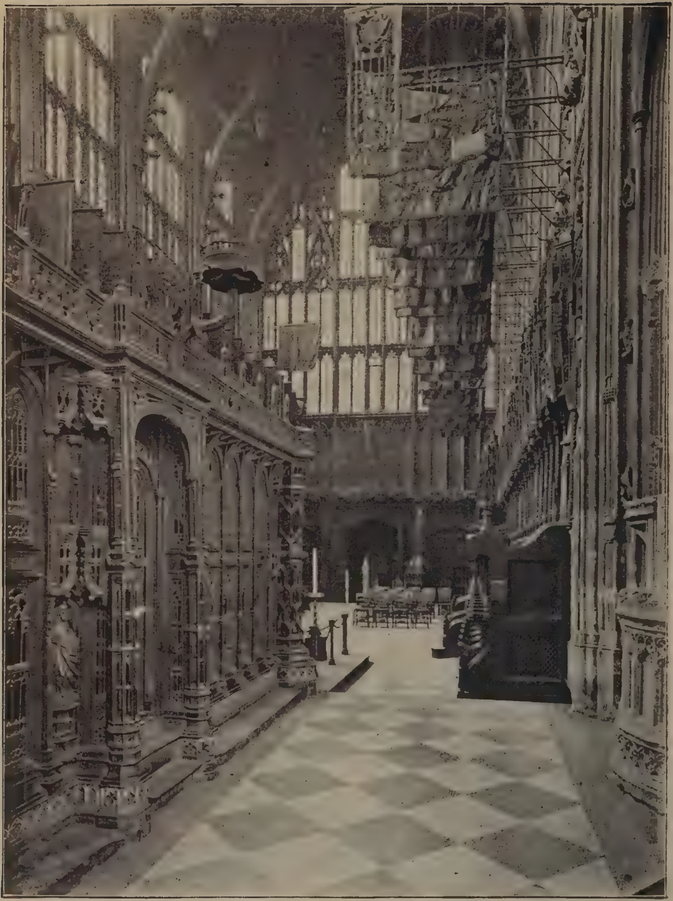
Sbisa, photo.

Taken with the

Goerz Anschutz Folding Camera

in $\frac{1}{1000}$th of a second.

(See page 398).



King Henry VII.'s Chapel, Westminster Abbey.

Original taken by W. Rice on whole plate with **Goerz Double Anastigmat No. 1,** at *f*.31 (the 5 × 4 lens of 6 in. focus).

The lens was raised about one inch from the centre, thus showing a covering power of more than 90 degrees.

(See page 396).

1. To do this, get a piece of cardboard with a serrated edge, or cut roughly to the outline of the picture (or a rough print cut out, such as I show you), and during exposure keep this constantly on the move in front of the sky portion of the negative, unless this is so dense that there is no fear of its printing through, then replace the ordinary negative by a sky one, and expose again, but this time shielding the portion of the slide which had been previously exposed, remembering that sky negatives require only one-sixth to one-tenth the time of the landscape. Then develop, and, if after fixing it is found that the sky encroaches too much on the landscape, a *very careful local* application of Farmer with a brush will remedy this.

2. This is probably a better way: mark the lantern plate on the slides where the landscape comes, as a guide, then, having exposed one plate for the landscape, take another plate, and expose for the sky, carefully shading as before the landscape part of the plate, as indicated by the marks previously made, with the serrated card, or cut out print as above, for the requisite time, and develop and fix. Now place the two slides, *i.e.*, landscape and sky, back to back, and carefully clear away any superabundant sky with Farmer and a brush. This answers very well for the black tones, but is not quite so easy for the warm tones, as it is difficult to exactly match the colours. I would suggest, as a good plan, to have a lot of cloud slides, made from different negatives, with different exposures, and different development, and consequently different colours, each carefully noted; you will then have always handy a sky negative for your landscape, and the only thing necessary will be to clear off any sky not wanted with Farmer.

3. This, with care, is a very good way; make your landscape slide and finish it, and then use it as a mask for the sky. Put into the frame first the landscape slide, then the sky negative film up, and then the lantern plate, and make the exposure, develop, fix, wash and dry. You will probably find a slight outline of some part of the landscape negative in the sky; if so, be careful that, in binding the two slides together, these portions exactly correspond.

6. Toning, &c.

I have at last reached the final division of the subject; but time is short, as I am anxious to *show* as well as *tell* you how to make slides, I must hurry on to a conclusion. I need not refer to intensification and reduction as means for improving slides, because I dealt very fully on this subject about this time last year, and my paper was published *in extenso* in The British Journal of Photography and the "Photographic News" at the time. Toning with gold, of which I show you a slide, is easy, using the sulphocyanide bath, but about twice the strength employed for P.O.P. Toning with platinum of which I show you two slides, is also easy, using the chloro-platinite salt dissolved in water acidulated with either nitric or citric acid. Either of these not only alters the colour of the slide, but produces a slight intensification. The various colours obtainable by variations in exposure and development I have already referred to. A red-coloured slide is obtainable by the uranium toning process, and it can be made still more red by dissolving away the silver with Farmer's solution; again, this uranium red slide may be turned into a blue one by immersion in the following bath:—

Strong solution of perchloride of iron	8 minims.
Hydrochloric acid	16 ,,
Water to	5 ounces.

A green colour is first obtained, which, by prolonged action, passes into blue. Schlippe's salt, about ten grammes to the ounce, may be used to alter and slightly intensify the image, but the colour, as you will see, is not a very pleasing one. Lastly, there is a new and very interesting process by Mr. W. B. Ferguson, Q.C., *i.e.*, "copper toning," and which is fully described in the last issue of THE BRITISH JOURNAL ALMANAC, p. 876. It is only necessary, therefore, to refer to it very briefly. The formula is as follows :—

10 per cent. sulphate copper	75 c. c. (70 minims).
10 per cent. solution ferricyanide potassium	66 c. c. (60 minims).
10 per cent. solution neutral potassium citrate	573 c. c. (2 ounces).

The solution obtained on mixing these is is of an emerald green colour, keeps well, and does not stain. Colours ranging from purple black to cherry-red are obtainable according to the time of immersion. I need hardly say that in all these toning processes washing must be thorough, and that daylight must be used to judge the various colours.

J. H. BALDOCK, F.C.S.

PHOTOGRAPHIC CLASSES AT THE LONDON POLYTECHNICS.

THE prospectuses of five of the London Polytechnic Institutes at which winter classes in photography are held are appended, and we give the necessary particulars for the information of those of our readers who may be desirous of taking advantage of the facilities afforded for gaining a knowledge of photography by class study :—

LONDON COUNTY COUNCIL SCHOOL OF PHOTO-ENGRAVING AND LITHOGRAPHY, 6 Bolt Court, Fleet Street, E.C.

The school is open to those who are genuinely engaged in business in any branch of the photo-mechanical, photographic, designing, lithographic, engraving, and printing crafts, and no provision whatever is made for amateurs. The courses of practical instruction are arranged to suit the following craftsmen :—

Photo-engravers.—Line and screen negative-making, etching, proving, tri-colour work.

Photo-lithographers.—Negative-making, photo-lithography, collotype (plate-preparation, press, and machine work), combinations of lithography and collotype.

Photographers.—Line and continuous tone negative-making, printing, enlarging, transparency-making.

Lithographers.—Lithography, map and plain drawing, transfer writing, drawing, design, lettering, photo-lithography.

Designers.—Design, drawing, lithography.

Draughtsmen.—Drawing, design, lettering.

The school is well equipped with the necessary appliances for study and practical work. It contains large studios for life and antique drawing, design-rooms, lithographic studio, lithographic press-room, photographic studio (with electric light installation), dark rooms, collotype preparation and printing-room (with three presses), etching-rooms, lecture-rooms, &c.

Only those engaged in the trade are admitted. The fee, which admits a student to the classes, is 3*s.* a term of three months, for those in receipt of not more than 30*s.* per week. For those in receipt of more than this sum the fee is 7*s.* 6*d.* a term. The photo-process department is open for day instruction, full particulars of which will be found in the prospectus, which may be obtained from the Principal of the School at the above address.

THE GOLDSMITHS' INSTITUTE, New Cross, S.E.

During the session 1901–2, on Friday evenings at 8.30, a series of twenty-six lectures and demonstrations on the theory and practice of photography will be given.

Students attending this course will be able, if desired, to sit for the City and Guilds' Examination in May, 1902, and the whole course of the above lectures will be in accordance with the City and Guilds' Syllabus. Fee for the six months' course, 7*s.* 6*d.* (exclusive of the City and Guilds' examination fee). In addition to the above, there will be the following practical courses, in which each student receives individual instruction:—

Monday afternoons, from 2.30 to 5, a special course of twelve indoor and three outdoor practical lessons for ladies only. Fee for the course, 10*s.* 6*d.*

Monday evenings, from 6.30 to 9, a special course of twelve indoor and three outdoor (Saturday afternoons) for ladies only. Fee for the course, 10*s.* 6*d.*

Tuesday evenings, from 7 to 10, a course of twelve indoor and three outdoor (Saturday afternoons) practical lessons in elementary photography for gentlemen. Fee for the course, 10*s.* 6*d.*

Wednesday evenings, from 7.30 to 10, a course of 24 lessons in photo-mechanical processes, photo-lithography collotype, half-tone blocks, and photogravure. Fee for the six months' course, 12*s.* 6*d.*

Thursday evenings, from 7.30 to 10, an advanced course of twelve practical lessons, comprising enlarging in bromide, making enlarged negatives, carbon, platinum, and gum-bichromate printing, &c. Fee 10*s.* 6*d.*

The photographic studio and dark rooms are very completely equipped, and are fitted with electric arc lamps for copying and portraiture. The department is provided with studio, landscape, lantern-slide, and copying cameras, an enlarging lantern, and a powerful electric projection lantern. It also has complete outfits for photo-lithographic and collotype work, for platinotype and carbon printing, and for retouching and other branches of modern photographic practice. Students must provide their own sensitive paper and plates, but all chemicals and apparatus required will be furnished by the Institute. Since the photographic classes are necessarily limited in number of students, applicants will be accepted in order of application. Should a sufficient number of applications be received, other classes will be held on separate evenings.

THE BATTERSEA POLYTECHNIC, Battersea Park Road, S.W.

Teacher of photography.—Mr. E. Senior.

Elementary (twenty-five lessons).—Lectures: Tuesdays, 7.30 to 8.30 p.m.; students, 4*s.*; amateurs, 6*s.* Practical: Tuesdays, 8.30 to 10 p.m.; students, 7*s.*; amateurs, 10*s.*

Advanced (thirty lessons).—Lectures: Thursdays, 7.30 to 8.30 p.m.; students, 5*s.*; amateurs, 7*s.* 6*d.* Practical: Thursdays, 8.30 to 10 p.m.; students, 10*s.*; amateurs, 12*s.*

The Advanced Course prepares students for the City and Guilds' Examinations.

The new regulations of the City and Guilds' Institute require students to pass a local practical examination before admission to the written examination in the Ordinary Grade.

The photographic department contains a large studio, fitted with Joel arc lamp and reflector, for photographic work at night; two commodious dark rooms, lit with electric lanterns and fitted up with every convenience for work. The equipment includes an 8½ × 8½ studio camera and lens, and 10 × 8 copying camera, fitted with Zeiss lens; an electric light enlarging apparatus with ten-inch condenser; a complete set of carbon and platinotype printing apparatus, and a special camera for lantern-slide making, so that ample provision exists for practical work. The classes are primarily intended for trade students, but others are admitted upon payment of higher fees.

Students will be provided with necessary chemicals and apparatus free of cost, but must provide their own plates, sensitive paper, &c.

Students who desire to gain a thoroughly sound knowledge of the science connected with photography are strongly advised to join a chemistry class, and to attend the lectures on light.

Syllabus.—Elementary.—Lectures on principles of photography, the camera and detached parts, the dark room and fittings, use of camera, plates, exposure, lenses, developers, defects, intensifiers, printing and toning, practical work in dark rooms, and instruction in taking and copying with electric light.

Advanced Lectures.—The studio, portraiture, lighting the model by daylight and electric light, use of screens, diffusers, &c.

The Dark Room.—Illumination of, and methods for testing safety of light.

Negatives.—Exposure of gelatine plates under every condition of light, subject, &c.; use of exposure tables, meters, &c.

Development.—Nature of development; the various substances in use, and their relative advantages and disadvantages.

Intensifying and Reducing.—Both wholly and locally; the preparation of gelatine emulsions; composition of, and defects in, gelatine plates.

Optics.—The construction and use of photographic lenses; testing lenses; preparation and use of colour screens for isochromatic photography; use of shades and instantaneous shutters; testing speed of shutters.

Colour Sensitometry.—The various forms of apparatus devised by Sir William Abney for adjusting light filters for use in ortho-chromatic and three-colour photography.

Photography in Colours.—Ives's, Joly's, Lippmann's, and diffraction processes.

Cameras.—Various forms and their use; camera stands; testing cameras.

Landscapes.—Choice of position, direction of light, &c.; use of view-meters.

Printing.—Printing in silver, carbon, and platinum, including vignetting; printing in clouds, &c.

Toning and Fixing.—Theory and practice of, with formulæ for various solutions.

Retouching and Spotting.—Mounting prints; theory and practice of the wet-plate process, both negative and positive.

Elementary Photographic Chemistry.—Simple test for ordinary photographic chemicals.

Enlarging.—General principles involved, and calculations in enlarging or reducing to scale.

Practical Classes.—Instruction will be given in negative-making, contact printing on bromide paper, silver, and platinum printing, general studio work, and lantern-slide making; wet-collodion process; single and double transfer carbon printing; artigue printing; and in the use of Dr. Albert's orthochromatic collodion emulsion.

Enlarging.—A special class in enlarging will be held on Tuesdays, 8.30 to 10 p.m. Fee for 10 lessons, 9*s.*; half course, 6*s.* An electric light enlarging apparatus has been added, and students joining this class will receive individual instruction in making plain and vignetted enlargements on bromide papers, and in modifying the colours of prints by toning.

THE NORTHAMPTON INSTITUTE.

The City Polytechnic, St. John Street Road, E.C.

Tri-colour Process Work and Colour Photography.—The following special lecture and practical courses for photo-process workers and general photographers have been arranged in co-operation with the London County Council School of Photo-engraving and Lithography, Bolt Court, E.C.

Tri-colour Process Work.—Lecturers: Mr. Charles W. Gamble (Bolt Court School), and Mr. A. J. Bull. A course of 12 lecture demonstrations with practical work, on Friday evenings, from October 4 to December 20 inclusive.

Lecture Demonstrations, Fridays, 7 to 8 p.m. Syllabus.—General introduction, nature of white and coloured light, absorption and reflection of colours, primary spectrum colours, and "primary" pigment colours, Maxwell's colour vision curves, choice of pigments and screens for tri-colour work, influence of order of printing, use of ruled screens, preparing sensitive plates, best conditions of lighting and using the camera, production of the negative, general outline of the production and treatment of blocks, selection of paper, printing.

Practical Work.—Laboratory work, Northampton Institute, Fridays, 8 to 10 p.m. Photo-process work, Bolt Court School, Tuesdays, 7 to 9.30 p.m. Only those engaged in the process trade can be admitted to the practical class at the Bolt Court School in accordance with the rule in the tri-colour class.

Colour Photography and Measurement.—Lecturer: Mr. A. J. Bull. A course of 7 lecture demonstrations with practical work, on Friday evenings, from January 10 to February 21 inclusive, as a continuation of the preceding course. The course is further intended for professional photographers and others having a good knowledge of ordinary photographic work, and who desire to become familiar with colour photographic processes.

Lecture Demonstrations, Fridays, 7 to 8 p.m, Syllabus.—Nature of white and coloured light, principle and use of spectroscope, Maxwell's colour-vision curves, addition and subtraction of colours, making and testing of colour screens, colour sensitiveness of photographic plates, orthochromatising choice and testing of dyes for orthochromatising.

Absorption Methods.—Explanation of Ives's, Joly's, and Lumière's processes and their working. Kromskop and other viewing arrangements.

Interference Processes.—Lippmann's process and its explanation; recent developments of Lippmann's process.

Primary and complementary colours, formation of all colours from primary colours, peculiarities of colour vision and colour blindness. Lovibond's tintometer, explanation and mode of use, measurement of colours and classification of pigments.

Half-tone Process Work.—Lecturer: Mr. Charles W. Gamble (Bolt Court School). A course of 6 lecture demonstrations with practical work at the Northampton Institute, on Friday evenings, from February 28 to April 11, 1902 The object of this course is to give the simplest possible exposition of the scientific principles underlying half-tone work, and also an account of the best practical methods and plant to be employed.

Lecture demonstrations, Fridays, 7.15 to 8.15 p.m.

Syllabus.—Object of breaking up half-tone into line and dot for relief printing, mechanical methods of converting bas-relief into line and dot, use of V tool, optical methods of breaking up, use of cross line screen, conditions for securing true optical V, influence of width of screen ruling, size and shape of stop, distance of screen and sensitiveness of plate on the result, practical details of process cameras, lenses, and accessories, lighting, exposure, and development, preparation of block, exposure, etching, &c., finishing blocks, fine etching, routing, details of finishing and printing machinery, choice of paper and printing.

Practical Work.—Laboratory work, Northampton Institute, Fridays, 8.15 to 9.30 p.m. Photo-process work, Bolt Court School, Mondays and Wednesdays, 7 to 9.30 p.m.

Fees.—Members or Associates, 10*s.*; non-members, 15*s.*, for the three courses. Members or Associates, 4*s.*; non-members, 5*s.* 6*d.*, for any single course. Particulars of the work carried on at the L.C.C. School of Photo-engraving can be had on application to the Principal of the school at 6 Bolt Court, Fleet Street, E.C.

PHOTOGRAPHIC TRADES SCHOOL, Regent Street, London.

In the area of Greater London the Photographic School of the Polytechnic holds the honourable record that a far greater proportion of those engaged in the various sections of the trade are present or past students of the School than is the case with any other industry and its corresponding school.

Subject.—Negative making; Developing; Camera manipulations; Exposures; Selection and use of lenses; Copying; Orthochromatic work; *Portraiture: Studio designs, Lighting (daylight and artificial); *Landscapes, architecture, &c. Teachers, Mr. Howard Farmer and several specialist lecturers. Tuesday, 8 to 10 p.m. Fee (5 months) 7*s.* 6*d.*

Subject.—Preparation of negatives for printing; Intensifying and reducing; Gelatino-chloride printing; Collodio-chloride printing: Albumen printing; Enamelling, mounting, and finishing; Platinum printing; Carbon printing. Teacher, Mr. Francis T. Beeson, F.R.P.S., Photographer to George Newnes, Ltd. Friday, 8 to 10 p.m. Fee (5 months) 10*s.* 6*d.*

Subject. — Bromide printing; Enlarging; Enlarged negative making; Lantern-slide printing. Teacher, Mr. John H. Gear, F.R.P.S., winner of over 100 medals at Exhibitions. Monday, 8 to 10 p.m. Fee (5 months) 10*s.* 6*d.*

Subject.—Retouching (elementary and advanced). Teacher, Mr. Wolfgang Arndt, Head Retoucher to chief London firms. Wednesday, extra class on Friday, 7.30 to 9.30 p.m. Fee (3 months) 10*s.* 6*d.*

Subject.—Finishing in black-and-white (elementary, advanced, and air-brush). Teacher, Mr. W. H. Windridge. Tuesday, extra class on Thursday, 7.30 to 9.30 p.m. Fee (3 months) 10*s.* 6*d.*

Subject.—Finishing in colour and miniature painting. Teacher, Mr. W. H. Windridge. Monday, 7.30 to 9.30 p.m. Fee (3 months) 10*s.* 6*d.*

Subject.—Photogravure (elementary and advanced). Teacher, Mr. Howard Farmer. Wednesday, 8 to 10 p.m. Fee (5 months) 10*s.* 6*d.*

Subject.—Line negative making (wet collodion and dry plate); Screen making (wet collodion and dry plate); Line blocks (zinc and copper); Tone blocks (zinc and copper). Teacher, Mr. Guy Simmons (five years with the Swan Engraving Company). Wednesday, extra class on Friday for advanced students, 7.30 to 9.30 p.m. Fee (5 months) 10*s.* 6*d.*

Subject.—Tri-colour photography. Teacher, Mr. Guy Simmons. Monday, extra class on Tuesday, 7.30 to 9.30 p.m. Fee (5 months) 10*s.* 6*d.*

NOTES.—Special detailed syllabus may be had on application. Personal inquiries at the Institute for information connected with the Photographic School should be made in the Photographic Department. Mr. Farmer will be glad to meet students, &c., by appointment, any evening. The above class fixtures may be subject to alteration.

* Practical instruction in these sections obviously cannot be given in the evening but full and detailed instructions for working will be given by special men, and the exposed plates can be developed and finished in the Class.

THE CITY AND GUILDS EXAMINATIONS.

THE following particulars relating to the City and Guilds Examinations in photography in 1902 are extracted from the official handbook :—

PHOTOGRAPHY.

The examination in photography will consist of two parts: Section A., Pure Photography; and Section B., Photo-Mechanical Processes. Candidates may be examined in *either* of these two sections.

ORDINARY GRADE.

The examination in the Ordinary Grade of either section will consist of a *practical* and a *written* examination.

No candidate will be admitted to the written examination who has not previously passed the practical examination.

To enable candidates to qualify for the written examination in the Ordinary Grade, local practical examinations will be held at convenient times in the session preceding the written examination. A practical examination may be held in any town where there is a class registered by the Institute, or in such other places, distant ten miles from the class, where *at least* five candidates notify, through the Local Secretary, their wish to be examined. The local examinations will be held under the personal supervision of examiners nominated by the local authority, subject to the approval of the Institute. The date at which a local examination is to be held may be fixed at any time between January 1 and March 1 that may be arranged between the Secretary of the Local Committee and the local examiner, provided that *at least fourteen days' notice* is given to the Institute of the date fixed for such local examination; and the Local Secretary will be required to forward to the Institute, within eight days after the holding of such examination, under the signature of the local examiner, the names of any candidates who may have satisfied the examiner of their practical knowledge of photography. The subjects of the test are given in the Syllabus of each section.

The candidate for the practical examination in either section may elect to make his negative in collodion or gelatine, and his print may be produced by any of the methods in ordinary use. He will also be allowed to supply, if he so desire, his own apparatus, chemicals, &c., or he may use those provided by the local examiner. The fee for the practical examination only will be 2*s.* 6*d.* The fee for the written examination is 1*s.*

SECTION A.—PURE PHOTOGRAPHY.

I.—*Syllabus.*

(1.) The local practical examination will include the following tests :—

To focus, expose, and develop a negative of a person or landscape; to print, tone, fix, and mount an ordinary print.

(2.) The written examination will include questions on such subjects as the following :—

1. The elements of photographic optics; the photographic camera and its adjuncts, lenses, diaphragms, shutters, shades, &c.

2. A general knowledge of the practice and theory of the wet-plate process.

3. The practice and theory of the gelatine dry-plate process, exclusive of emulsion-making; the composition of, and defects in, gelatine dry plates; the defects of gelatine negatives, their causes and remedies.

4. Various methods of developing, fixing, intensifying, and reducing negatives, with a general knowledge of the chemicals employed.

5. Silver printing by print-out processes, including vignetting and printing in clouds, toning, and fixing; contact printing on gelatino-bromide paper.
6. Retouching and spotting; mounting prints.
7. The lighting of the dark room.
8. The studio and lighting of the sitter.

SECTION B.—Photo-Mechanical Process.

(1.) The local practical examination will include the following tests:—

To focus, expose, and develop a negative of a drawing in line or wash; to prepare or etch a zinc or copper plate (*a*) for a process block, (*b*) for a photogravure plate; to make a collotype plate or a photo-litho transfer.

(2.) The written examination will include questions founded on the following subjects:—

1. Cameras and lenses for copying and process work, ruled screens, prisms, reversing mirrors, the appliances in ordinary use for electric and artificial lighting for photographic purposes, and the apparatus employed in photo-mechanical processes.
2. A practical knowledge of collodion (wet and dry), and gelatine dry plate photography.
3. A general knowledge of various methods of developing, fixing, intensifying, and reducing negatives.
4. A general knowledge of the properties of gelatine, albumen, fish-glue, bitumen, resin, inks, etching solutions, and other chemicals and materials used in photo-mechanical work.

The principles and practice of at least two of the following processes:—

5. Photogravure.
6. Block making—line, half-tone, and three-colour.
7. Photo-lithography.
8. Collotype.

The written examinations in the Ordinary and Honours Grades will be held on Wednesday, April 23, from 7 to 10 p.m.

Honours Grade.

Candidates for Honours in either section must have previously passed in the Ordinary Grade of that section.

The Honours Examination is both written and practical.

The fee for the Honours Examination (written and practical) in either section is 3*s.* 6*d.*

For the year 1902, practical examinations will be held in London only, unless ten candidates at least apply to be examined in the same section (A or B) at some other centre.

SECTION A.—Pure Photography.

(1.) Written Examination.—Candidates will be expected to answer more difficult questions in the subjects for the Ordinary Grade, and, in addition, a knowledge will be required of:—

1. The theory of the photographic image, of development, fixing, intensification, and reduction.
2. The theory of light as applied to photography, including a general knowledge of spectrum and orthochromatic photography.
3. The principles of photographic optics.
4. The theory and practical use of sensitometers for testing the speed and gradation of plates, and also their uses in printing processes.

5. The principles and practice of the preparation of gelatino-bromide and gelatino-chloride emulsions.
6. Collodio-bromide emulsions—their preparation and use.
7. Platinotype and carbon printing; other methods of printing with bichromates and with iron salts; enamels.
8. Enlargements and lantern slides.
9. Applications of photography to scientific and technical purposes.

(2.) Practical Examination.—Candidates will be required to show proficiency in conducting, in presence of the examiner, any of the following practical operations:—

1. To develop gelatino-bromide plates previously exposed (correctly or otherwise) by the examiner.
2. To reduce or intensify gelatino-bromide negatives.
3. To print, tone or develop, fix, and mount a silver, platinotype, or carbon print.
4. To test a sample of glass or fabric to be used in lighting the dark room.
5. To test the sensitiveness and gradation of a plate.
6. To find the focus of a lens either corrected or uncorrected, or to examine a lens as to its suitability for different photographic purposes.
7. To copy a drawing or engraving.
8. To make an enlargement from quarter-plate.
9. To make a lantern slide by contact or in a camera.

The practical examination will be held on Saturday, April 26, between 2.30 and 6.30 p.m., and at other times if found necessary.

(3.) Specimen Work.—Candidates will also be required to send in, not later than April 16, not fewer than three nor more than six negatives, not less than quarter-plate size nor more than whole-plate, together with mounted prints made from each of them by any ordinary photographic printing process or processes that the candidate may select. The negatives and prints must be accompanied by a statutory declaration made by the candidate to the effect that the selection of the subjects and the whole of the work (except the manufacture of the plates, sensitive paper, and mounts) involved in the production of the negatives and prints has been done by the candidate without assistance from any other person, and within the twelve months preceding the date of the examination. Forms for the declaration may be obtained from the Institute.

SECTION B.—PHOTO-MECHANICAL PROCESSES.

(1.) Written Examination.—Candidates will be expected to answer more difficult questions in some of the subjects of the Ordinary Grade, and, in addition, to show a practical knowledge of the principles and operations in one or more of the following processes:—

1. Photogravure.
2. Line negatives and line blocks.
3. Half-tone negatives and half-tone blocks.
4. Chromotypography (negatives and blocks for three-colour process).
5. Photo-lithography.
6. Collotype.

(2.) Practical Examination.—Candidates may be required to show proficiency in practical operations in one or more of the above processes, numbered 1, 2, 3, 4, 5, 6, including the preparation of negatives suitable for each class of work, from (*a*) pictures in colour, (*b*) drawings in monochrome, (*c*) originals in black and in tints, (*d*) natural objects.

Candidates in Section B may select the particular branch of practical work in which they desire to be examined.

In order that candidates may know what apparatus and material they will be required to provide for the practical part of the examination in Section B full information as to the practical tests may be obtained from the Local Secretary on Friday, April 25, for the examination to be held on the following day.

The practical examination will be held on Saturday, April 26, between 2.30 and 7.30 p.m., and at other times if found necessary.

II. Full Technological Certificate.—Certificates are awarded on the result of each of the above examinations. For the full technological certificate the candidate must qualify as stated in Rules 41, 42.

III. Works of Reference —For the ordinary grade: "Instructions in Photography," Abney (Sampson Low & Co.); "Ilford Manual of Photography," Bothamley; "Science and Practice of Photography," Chapman Jones (Iliffe); "Wet Collodion Photography," C. W. Gamble (Hazell, Watson, & Viney); "Art and Practice of Silver Printing," Abney and Robinson (Sampson Low & Co); "Materia Photographica," Leaper (Iliffe). For honours, in addition to the foregoing (Section A): "Optics of Photography," Traill Taylor; "Chemistry of Photography," Meldola (Macmillan); "Treatise on Photography," Abney (Longmans); "The Chemical Effect of the Spectrum," Eder; "La Photographie," by A. Davanne (Paris); "Platinotype," by Abney and Clark (Sampson Low & Co., London). For reference: "Traité Encyclopédique de Photographie," Fabre (Gauthier-Villars); "Ausführliches Handbuch der Photographie," Eder (Knapp); "Handbuch der Photographie," H. W. Vogel (Oppenheim); the "Dictionary of Photography," Wall and Bolas (Hazell, Watson, & Viney); the "Annals of Photography," in *Photography Annual.* Section B: "Modern Heliographic Processes," Ernest Lietze (Nostrand Co., New York); "Collotype and Photo-Lithography," Schnauss (Iliffe); "Photogravure," Wilkinson (Iliffe); "Photo-engraving, Half-tone Enamel Process," Whittel (Scovell Co., New York); "The Half-tone Process," Verfasser (Percy Lund); "Half-tone on the American Basis," Cronenberg and Gamble (Percy Lund, "Photo-engraving," Farquhar (Dawbarn & Ward); "Photo-lithography," Fritz and Wall (Dawbarn & Ward

TABLE FOR CONVERTING GRAINS AND DROPS PER OUNCE INTO GRAMMES PER LITRE AND *VICE VERSA.*

1000:480	$1000:437\frac{1}{2}$		$437\frac{1}{2}:1000$	480:1000
$\frac{3}{25}$	$\frac{7}{64}$	$\frac{1}{4}$	$\frac{4}{7}$	$\frac{25}{48}$
$\frac{4}{25}$	$\frac{7}{48}$	$\frac{1}{3}$	$\frac{16}{21}$	$\frac{25}{36}$
$\frac{6}{25}$	$\frac{7}{32}$	$\frac{1}{2}$	$1\frac{1}{7}$	$1\frac{1}{24}$
$\frac{8}{25}$	$\frac{7}{24}$	$\frac{2}{3}$	$1\frac{11}{21}$	$1\frac{7}{18}$
$\frac{9}{25}$	$\frac{21}{64}$	$\frac{3}{4}$	$1\frac{5}{7}$	$1\frac{9}{16}$
$\frac{12}{25}$	$\frac{7}{16}$	1	$2\frac{2}{7}$	$2\frac{1}{12}$
$\frac{24}{25}$	$\frac{7}{8}$	2	$4\frac{4}{7}$	$4\frac{1}{6}$
$1\frac{11}{25}$	$1\frac{5}{16}$	3	$6\frac{6}{7}$	$6\frac{1}{4}$
$1\frac{23}{25}$	$1\frac{3}{4}$	4	$9\frac{1}{7}$	$8\frac{1}{3}$
$2\frac{2}{5}$	$2\frac{3}{16}$	5	$11\frac{3}{7}$	$10\frac{5}{12}$
$2\frac{22}{25}$	$2\frac{5}{8}$	6	$13\frac{5}{7}$	$12\frac{1}{2}$
$3\frac{9}{25}$	$3\frac{1}{16}$	7	16	$14\frac{7}{12}$
$3\frac{21}{25}$	$3\frac{1}{2}$	8	$18\frac{2}{7}$	$16\frac{2}{3}$
$4\frac{8}{25}$	$3\frac{15}{16}$	9	$20\frac{4}{7}$	$18\frac{3}{4}$
$4\frac{4}{5}$	$4\frac{3}{8}$	10	$22\frac{6}{7}$	$20\frac{5}{6}$
$5\frac{7}{25}$	$4\frac{13}{16}$	11	$25\frac{1}{7}$	$22\frac{11}{12}$
$5\frac{19}{25}$	$5\frac{1}{4}$	12	$27\frac{3}{7}$	25
$6\frac{6}{25}$	$5\frac{11}{16}$	13	$29\frac{5}{7}$	$27\frac{1}{12}$
$6\frac{18}{25}$	$6\frac{1}{8}$	14	32	$29\frac{1}{6}$
$7\frac{1}{5}$	$6\frac{9}{16}$	15	$34\frac{2}{7}$	$31\frac{1}{4}$
$7\frac{17}{25}$	7	16	$36\frac{4}{7}$	$33\frac{1}{3}$
$8\frac{4}{25}$	$7\frac{7}{16}$	17	$38\frac{6}{7}$	$35\frac{5}{12}$
$8\frac{16}{25}$	$7\frac{7}{8}$	18	$41\frac{1}{7}$	$37\frac{1}{2}$
$9\frac{3}{25}$	$8\frac{5}{16}$	19	$43\frac{3}{7}$	$39\frac{7}{12}$
$9\frac{3}{5}$	$8\frac{3}{4}$	20	$45\frac{5}{7}$	$41\frac{2}{3}$
$14\frac{1}{25}$	$13\frac{1}{8}$	30	$68\frac{4}{7}$	$62\frac{1}{2}$
$19\frac{1}{5}$	$17\frac{1}{2}$	40	$91\frac{3}{7}$	$83\frac{1}{3}$
24	$21\frac{7}{8}$	50	$114\frac{2}{7}$	$104\frac{1}{6}$
$28\frac{4}{5}$	$26\frac{1}{4}$	60	$137\frac{1}{7}$	125
$33\frac{3}{5}$	$30\frac{5}{8}$	70	160	$145\frac{5}{6}$
$38\frac{2}{5}$	35	80	$182\frac{6}{7}$	$166\frac{2}{3}$
$43\frac{1}{5}$	$39\frac{3}{8}$	90	$205\frac{5}{7}$	$187\frac{1}{2}$
48	$43\frac{3}{4}$	100	$228\frac{4}{7}$	$208\frac{1}{3}$
$52\frac{1}{2}$	$47\frac{109}{128}$	$109\frac{3}{8}$	250	$227\frac{83}{96}$
$57\frac{3}{5}$	$52\frac{1}{2}$	120	$274\frac{2}{7}$	250
70	$63\frac{77}{96}$	$145\frac{5}{6}$	$333\frac{1}{3}$	$307\frac{1}{4}$
$76\frac{4}{5}$	70	160	$365\frac{5}{7}$	$333\frac{1}{3}$
105	$95\frac{45}{64}$	$218\frac{3}{4}$	500	$455\frac{35}{48}$
$115\frac{1}{5}$	105	240	$518\frac{4}{7}$	500
120	$109\frac{3}{8}$	250	$571\frac{3}{7}$	$520\frac{5}{6}$

When a number in the central column is that of the grains per avoirdupois ounce, the proportionate number of grammes per litre will be found next to it on the *right* hand.

When a number in the central column is that of the grammes per litre, the proportionate number of grains per avoirdupois ounce will be found next to it on the *left* hand.

Thus, 70 grains per ounce (central column) are equivalent to 160 grammes per litre (right hand).

Again, 16 grammes per litre (central column) are equivalent to 7 grains per avoirdupois ounce (left hand).

The outer columns may be used in conjunction with the central one in the same way, to convert drops per fluid ounce into c.c. per litre and *vice versâ.*

WEIGHTS AND MEASURES.

By the Weights and Measures Act, 1878 (41 and 42 Vict., c. 49), every contract, bargain, or dealing, for any work done, goods, wares, or merchandise sold, &c., by weight or measure, shall be according to the weights or measures ascertained by this Act, and, if not so made, shall be void.

No local or customary measures, nor the use of heaped measure, shall be lawful.

Any person who sells by any denomination of weight or measure other than one of the Imperial weights or measures, shall be liable to a fine of 40*s.* for every such sale.

All articles sold by weight shall be sold by Avoirdupois weight; except that—

1. Gold and silver, and articles made thereof, also platinum, diamonds, and other precious metals or stones, may be sold by the oz. Troy, or the decimal parts of such oz.
2. Drugs, when sold by retail, may be sold by Apothecaries' weight.

Nothing in this Act shall prevent the sale or subject a person to a fine for the sale of an article in any vessel not represented as containing any amount of Imperial measure.

Every person who uses or has in his possession for use for trade, a weight or measure which is not of the standard denomination, shall be liable to a fine of £5, and for a second offence £10.

UNJUST WEIGHTS AND MEASURES.

Every person who uses or has in his possession for use, for trade, any weight, measure, or scale, &c., which is false or unjust, shall be liable to a fine of £5, and for a second offence, £10; and any contract, sale, or dealing made by the same shall be void.

STAMPING AND VERIFICATION OF WEIGHTS AND MEASURES.

All weights and measures must have the denomination thereof stamped thereon.

Every weight and measure whatsoever, used for trade, shall be verified and stamped, by an inspector, with a stamp of verification.

Any person who uses, or has in his possession for use, for trade, any measure or weight not duly stamped, shall be liable to a fine of £5 for the first offence, and £10 for the second.

The above has been extracted from "Every Man's Own Lawyer." We may add that the working of the Act is under the Board of Trade) and that all details are prescribed by Orders in Council. The King in Council has power to sanction certain things, and by an Order of this sort, dated 19th May last, the use of Metric weights and measures was sanctioned. The making of Metric standards was sanctioned by the Weights and Measures Act, of 1897. The equivalents to be used in future (in lieu of those prescribed by the Act of 1878) are directed in a subsequent Order, and are those given in p. 582 of the ALMANAC for last year.

FORMULÆ.

With the view of enabling the readers of the Almanac to find any particular one of the following numerous Formulæ or Tables, we give below an Index to the Contents of this section of the Almanac, which will doubtless facilitate reference.

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ABOUT WEIGHTS AND MEASURES.

The inconveniences of the English system of weights and measures has long been felt by all who are engaged in any form of research. It is not a question of the units so much as of their divisions. If it were only a matter of English convenience, there would probably be little desire to change the pound and the yard, which are our standards, and it would only be a question of dividing them suitably. But decimal division and multiplication of these units, or their subordinate ones, is practically impossible to avoid, and no one can help feeling the advantage which would follow from universal decimalisation, at least no one who has much to do with the calculations necessary for modern science, which reduces all things to number, weight, and measure. If this decimalisation were taken in hand with our present units (standards), it would be necessary to devise new names for some subordinate units, and to make them such as would clearly distinguish them from the old system. No one surely would seriously propose to deliberately add to the confusion we already enjoy of having two ounces, three drachms, and two pounds (not to speak of the monetary unit represented by a sovereign) which are a constant source of confusion, even though some of these are not sanctioned by law. Besides, if we retain our units, we should still be under the disadvantage in our commerce of differing in our units from all our neighbours, and in our science of want of ready connexion between our units of length and weight. There have been several suggestions made for decimalising our weights; of these the best probably was that the avoirdupois pound, of 7000 grains, should be divided into 1000 parts, to be called septems, and that the measure of fluids should correspond to a pound of pure water and be divided similarly, but nothing has ever come of this. Recently, indeed, a proposal was made to adopt a new pound of 8000 grains, divided into 16 ounces of 500 grains each, thus adding to our confusion for the sole purpose of getting an ounce of a round number of grains, for it is difficult to see what other gain there would be.

If there is to be a change, then, the new system should be free from as many as possible of the disadvantages of what we have, and not be liable to require further modification. One solution only seems possible, and that is that Englishmen take the advice of, and follow the practice of, the most scientific portion of their body, and adopt the metric system in its entirety. The units are not practically inconvenient, nor are the names of them really difficult to deal with; and, if they were so, objections would come with a bad grace from photographers, whose journals teem with words of Greek and Latin derivation, awful to look at and far worse to pronounce than kilo, gramme, metre, litre, or c. c.

Whether our readers are prepared to go the whole length with us or no (and the retention of the old forms should meet the convenience of the most conservative) we think there is another convenience arising from the step now taken. It must be well known to all that the use of percentages, and even of what are called parts, has become a practice in photographic work. What the advantage of parts, as lately used, is we fail to see; but the use of percentages is a practical confession of the advantage of decimalisation. It is proposed to adopt here one uniform quantity of the solution to be made up, that is the litre of 1000 cubic centimetres, and containing 1000 grammes of pure water. The quantities of each constituent will be given in grammes or cubic centimetres (c. c.), according as it is solid or fluid, and, as a rule, fractions of a gramme will be neglected.

The English grains per ounce have been converted into grammes per litre by multiplying them by $\frac{16}{7}$, and drops per ounce into c. c. per litre by the factor $\frac{25}{12}$.

It has been suggested that the accuracy of these conversions is excessive, but it has been thought better to leave the expert to adopt more convenient figures, rather than to make the author of a formula responsible in appearance for what he did not sanction. In a few cases where the author has given his formula both in English and metric form, his equivalents have been adhered to, and it is hoped that this practice will be more general in future.

Those who prefer percentages will find their wants met if they bear in mind that one-tenth of the quantities given will make 100 c. c. of solution, and be, in fact, percentages. The gentlemen who wish to make use of parts will find that, by reading *parts* for grammes or c. c., they will have formulæ quite as accurate as those they have been in the habit of using.

In some cases there is a doubt whether the author of a formula means that the solution should be made up to the quantity directed to be made, or whether he means the amount of water specified to be added. It would be accordant with uniformity to take the latter view; in many cases it does not much matter which is taken, but, when there is a large quantity of water of crystallisation in the substance used, it may be material, and it would be very desirable if all photographers would distinctly state which mode of mixing they mean to be followed. Where sodium sulphite, for instance, is employed in crystals, no less than half the weight is water. In this common salt it is stated in the Solubility Tables that a saturated solution contains twenty-five per cent., but much stronger solutions are prescribed, in one case fifty per cent. is ordered in a standard work on our art. In this case, if 5 parts of salt (in crystals) is dissolved in hot water and the solution made up to 10 parts, we have virtually 2·5 parts of the anhydrous salt in the 10 parts, that is, a twenty-five per cent. solution, saturated at ordinary temperatures but liable to change when it is cold; but, if 10 parts of water are used to dissolve the 5 of salt, the solution will only contain twenty per cent. of anhydrous salt, and probably would always be unchanged in any workroom.

TABLE FOR THE CONVERSION OF ENGLISH WEIGHTS AND MEASURES IN THE METRICAL SYSTEM.*

LIQUID MEASURE.

Minims.	c.cm.	Minims.	c.cm.
1	0·0591	53	3·1352
2	0·1183	54	3·1943
3	0·1775	55	3·2535
4	0·2366	56	3·3126
5	0·2957	57	3·3718
6	0·3549	58	4·4309
7	0·4141	59	3·4901
8	0·4732	60	3·5492
9	0·5324		
10	0·5915	Drachms.	c.cm.
11	0·6507		
12	0·7098	1	3·5492
13	0·7690	2	7·0985
14	0·8282	3	10·6477
15	0·8873	4	14·1970
16	0·9465	5	17·7462
17	1·0056	6	21·2954
18	1·0648	7	24·8447
19	1·1239	8	28·3939
20	1·1831		
21	1·2422	Ounces.	c.cm.
22	1·3014	1	28·394
23	1·3605	2	56·788
24	1·4197	3	85·182
25	1·4789	4	113·576
26	1·5380	5	141·970
27	1·5972	6	170·364
28	1·6563	7	198·757
29	1·7155	8	227·151
30	1·7746	9	255·545
31	1·8338	10	283·939
32	1·8929	11	312·333
33	1·9521	12	340·727
34	2·0112	13	369·120
35	2·0704	14	397·515
36	2·1295	15	425·909
37	2·1887	16	454·303
38	2·2478	17	482·697
39	2·3070	18	511·091
40	2·3662	19	539·484
41	2·4253	20	567·878
42	2·4845		
43	2·5436	Pints.	c.cm.
44	2·6028		
45	2·6619	1	567·9
46	2·7211	2	1135·8
47	2·7802	3	1703·6
48	2·8394	4	2271·5
49	2·8985	5	2839·4
50	2·9577	6	3407·3
51	3·0169	7	3975·1
52	3·0760	8	4543·0

LINEAL MEASURE.

Inches.	Feet.	Yards.	Fathoms.	m
1 =	0·083 =	0·0278 =	0·0139 =	0·0254
12 =	1	= 0·333	= 0·1667	= 0·3048
36 =	3	= 1	= 0·5	= 0.9144
72 =	6	= 2	= 1	= 1·8287

AVOIRDUPOIS WEIGHT INTO GRAMMES.

Drachms.	Ounces.	Pounds (lbs.)	g.
1 =	0·0625 =	0·0039 =	1.77185
16 =	1	= 0·0625 =	28·3495
256 =	16	= 1	= 453·59

APOTHECARIES' WEIGHT.

Grains.	Scruples.	Drachms.	Ounces.	Pound.	g.
1	0·05	0·0167	0·00209	0·00017	0·0648
20	1	0·334	0·0418	0·00347	1·2960
60	3	1	0·125	0·01042	3·8879
480	24	8	1	0·08333	31·103
5760	218	96	12	1	373·236

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* See also pp. 600–604 ; 1049–50.

DEVELOPING FORMULÆ FOR GELATINE DRY PLATES, ETC.

THE following are a few of the typical formulæ that are generally employed for development, &c.; a much greater variety will be found in the section headed 'Developing Formulæ of the Principal Plate-makers' (p. 1098 *et seq.*), to which we also refer the reader.

PYRO SODA.

No. 1.	A.	Sulphite of soda	6 ounces	or	188 grammes.
		Water	32 ,,	,,	1000 c. c.
		Pyrogallic acid	1 ounce	,,	31 grammes.

(Having dissolved the sulphite of soda, add sufficient citric acid in solution to cause a piece of blue litmus paper inserted therein to become reddened.)

	B.	Carbonate of soda	3 ounces	or	94 grammes.
		Carbonate of potash	1 ounce	,,	31 ,,
		Water	32 ounces	,,	1000 c. c.

When about to develop, mix these in equal proportions with two parts the bulk of water, or, if the weather be *very* hot at the time, even a greater proportion of water.

No. 2.	A.	Sulphite of soda (crystals)	2 ounces	or	166 grammes.
		Citric acid	60 grains	,,	11 ,,
		Ammonium bromide	40 ,,	,,	8 ,,
		Pyro	1 ounce	,,	83 ,,
		Water	12 ounces	,,	1000 c. c.
	B.	Sulphite of soda (crystals)	2 ounces	or	166 grammes.
		Carbonate potassium (crys.)	3 ,,	,,	250 ,,
		Water	12 ,,	,,	1000 c. c.

To develop, use 1 drachm (or 6 c. c.) of each to 2 ounces (or 100 c. c.) of water.

PYRO AND AMMONIA.

No. 1.	Strong liquid ammonia	2 ounces	or	25 c. c.
	Bromide potassium	300 grains	,,	9 grammes.
	Water	80 ounces	,,	1000 c. c.
No. 2.	Pyrogallic Acid	20 grains	or	4·6 grammes.
	Water	10 ounces	,,	1000 c. c.
	Nitric acid	2 drops	,,	0·5 ,,

For use take equal parts.

FERROUS OXALATE.

No. 1.	Saturated solution of sulphate of iron	1 part.
	Saturated solution of oxalate of potash	3 parts.

Mix *quant. suff.* by pouring the iron into the oxalate. In hot weather the proportion of the iron solution may be diminished with advantage.

For Transparencies on Gelatino-Chloride Plates.

No. 2. A.	Neutral oxalate of potash	2 ounces	or	100 grammes.
	Chloride of ammonium ...	40 grains	,,	4·5 ,,
	Distilled water..............	20 ounces	,,	1000 c. c.
B.	Sulphate of iron	4 drachms	or	34 grammes.
	Citric acid	2 ,,	,,	17 ,,
	Alum........................	2 ,,	,,	17 ,,
	Distilled water..............	16 ounces	,,	1000 c. c.

For black tones mix the above in equal volumes.

METOL.

Single-solution Developer.

Metol	40 grains	or	11 grammes.
Sulphite of soda	120 ,,	,,	34 ,,
Hydroquinone	48 ,,	,,	14 ,,
Carbonate of potash..............	240 ,,	,,	69 ,,
Water	8 ounces	,,	1000 c. c.

Apply heat if necessary to dissolve the metol, and afterwards add the sulphite, and allow that to dissolve before adding the other ingredients.

For use under normal conditions, one part of the above is to be diluted with three parts of water.

Two-solution Developer.

A.	Metol	40 grains	or	11 grammes.
	Hydroquinone	48 ,,	,,	14 ,,
	Sulphite of soda	120 ,,	,,	34 ,,
	Water	8 ounces	,,	1000 c. c.
B.	Carbonate of potash...............	1 ounce	or	13 grammes.
	Water	1 quart	,,	1000 c. c.

For use, mix one part of A with three parts of B for ordinary exposures; for over-exposures use less of B, or else add a few drops of a ten per cent. solution of bromide of potassium, or of a five per cent. solution of citric acid; for slight under-exposure, increase B.

The 'WELLINGTON' BRAND
Is a Guarantee of the
HIGHEST QUALITY.

Three-solution Developer.

A.	Metol	40 grains	or	11 grammes.
	Sulphite of soda	120 ,,	,,	34 ,,
	Water	8 ounces	,,	1000 c. c.
B.	Hydroquinone	40 grains	or	11 grammes.
	Citric acid	10 ,,	,,	3 ,,
	Water	8 ounces	,,	1000 c. c.
C.	Carbonate of potash	1 ounce	or	50 grammes.
	Water	20 ounces	,,	1000 c. c.

For use under similar conditions to those already mentioned, take one part each of A and B and two parts of C.

METOL-HAUFF.

Solution A.

Water	100 parts	or	1000 c. c.
Metol	1 part	,,	10 grammes.
Soda sulphite	10 parts	,,	100 ,,

Solution B.

Water	100 parts	or	1000 c. c.
Carbonate potash (or substitute)	10 ,,	,,	100 grammes.
Crystallised carbonate soda	20 ,,	,,	200 ,,

For use three parts A to one of B.

METOL-ANDRESEN.

Water	1 quart	or	1000 c. c.
Metol	¾ ounce	,,	19 grammes.
Sulphite of soda	7 ounces	,,	175 ,,
Carbonate of potash	3½ ,,	,,	88 ,,
Bromide of potassium	⅒ ounce	,,	2·5 ,,

For use, take one part of developer to three of water.

The 'WELLINGTON' FILMS.

DAYLIGHT Cartridges, Cut SHEETS, &c.

To photographers who prefer to work with separate solutions the following is recommended:—

A.	Water	1 quart	or 1000 c. c.
	Metol	¾ ounce	,, 19 grammes.
	Sulphite of soda	7 ounces	,, 175 ,,
B.	Water	3 quarts	or 1000 c. c.
	Carbonate of soda	7 ounces	,, 58 grammes.

One part of A is mixed with three parts of water for use, bromide of potassium being added as required for the prevention of fogging.

ANDRESEN'S GLYCIN.

I. For soft development:

Solution A (warm slightly).

Glycin	4 parts	or 40 grammes.
Carbonate of potash	1½ ,,	,, 15 ,,
Sulphite of soda (cryst.)	12 ,,	,, 120 ,,
Water	100 ,,	,, 1000 c. c.

Solution B.

Carbonate of potash	10 parts	or 100 grammes.
Water	100 ,,	,, 1000 c. c.

For use mix one part of *A* with two parts of *B*.

II. For hard development:

Glycin	5 parts	or 50 grammes.
Carbonate of potash	25 ,,	,, 250 ,,
Sulphite of soda (cryst.)	25 ,,	,, 250 ,,
Water	100 ,,	,, 1000 c. c.

For use to be diluted three times its volume.

GLYCIN-HAUFF.

The concentrated developer is made up as follows:—350 grains (80 grammes) of sodium sulphite crystal are dissolved by heat in one ounce (100 c. c.) of water, 150 grains (35 grammes) of glycin are then added and the mixture is to be heated to boiling point, and one and a half ounces (150 grammes) of potash carbonate are added (begin adding the potash in small quantities, on account of the carbonic acid gas). When cold, this concentrated developer—forming a thin, pasty solution—may be

— THE —
'WELLINGTON' Photographic
Papers and Films
Specially recommended FOR EXPORT.

kept as stock. For use, shake the solution first, and dilute the required quantity twelve times for ordinary purposes. For use when development is to be left to itself, the stock solution is diluted fifty times.

A One-solution Formula.

Sodium sulphite	40 grains	or	23 grammes.
Glycin	20 ,,	,,	11 ,,
Potassium carbonate	80 ,,	,,	46 ,,
Water	4 ounces	,,	1000 c. c.

PARA-AMIDOPHENOL.

Para-amidophenol chlorhydrate	5 grammes.
Crystallised carbonate of sodium	50 ,,
Crystallised sulphite of sodium	50 ,,
Water	1000 ,,

For use, dilute with an equal bulk of water.

Para-amidophenol hydrochlorate	60 grains	or	7 grammes.
Sodium sulphite	60 ,,	,,	7 ,,
,, carbonate	400 ,,	,,	46 ,,
Water	20 ounces	,,	1000 c. c.

Dr. Andresen's Formula.

Para-amidophenol chlorhydrate	8 parts or grammes.
Sodium sulphite	80 ,, ,, ,,
,, carbonate	40 ,, ,, ,,
Water	1000 ,, ,, c. c.

PYROCATECHIN.

A.	Pyrocatechin	192 grains	or	20 grammes.
	Sodium sulphite	1½ ounces	,,	80 ,,
	Distilled water	20 ,,	,,	1000 c. c.
B.	Potassium carbonate	2 ounces	or	100 grammes.
	Distilled water	18 ,,	,,	1000 c. c.

For use mix 1 part of A with 2 parts of B.

The 'WELLINGTON'
ENAMMO Glazed Surface Bromide.
ROSE, WHITE, and MAUVE.

Another formula containing sufficient phosphate and caustic soda to form sodium tribasic phosphate, is the following:—

A.	Pyrocatechin	192 grains	or	20 grammes.
	Sodium sulphite	4 ounces	,,	100 ,,
	Distilled water	20 ,,	,,	1000 c. c.
B.	Sodium phosphate	450 grains	or	47 grammes.
	Caustic soda	48 ,,	,,	4 ,,
	Distilled water	20 ,,	,,	1000 c. c.

For use mix 1 part A, 1 part B, and 1 part water.

AMIDOL.

Amidol	80 grains	or	23 grammes.
Sodium sulphite	800 ,,	,,	230 ,,
Water	8 ounces	,,	1000 c. c.

For use, one ounce of the solution is diluted with three ounces of water, with one and a half grains of potassium bromide to the ounce of developer.

EIKONOGEN.

No. 1.	A.	Crystalline sulphite of soda	40 grammes.
		Eikonogen	13 ,,
		Distilled water	500 c. c.
	B.	Carbonate of potash (or calcined soda)	60 to 75 grammes.
		Distilled water	500 c. c.

For use, mix equal volumes of A and B.

ONE-SOLUTION DEVELOPER.

Sulphite of soda in crystals	8 ounces	or	100 grammes.
Carbonate of soda in crystals	3 ,,	,,	38 ,,
Distilled water	80 ,,	,,	1000 c. c.
Eikonogen	1 ounce	,,	13 grammes.

HYDROQUINONE.

No. 1.	Hydroquinone	1 part	or	15 grammes.
	Sulphite of soda	2 parts	,,	30 ,,
	Carbonate of soda	10 ,,	,,	150 ,,
	Water	67 ,,	,,	1000 c. c.

The 'WELLINGTON'

Pink, Mauve,
White, and Matt.
P. O. P.

'ORDINARY,' for the Phosphate and Formate Toning Baths.

No 2.	A.	Hydroquinone	4 grains	or	9 grammes.
		Metabisulphite of potash	4 ,,	,,	9 ,,
		Bromide of potassium	1 grain	,,	23 ,,
		Distilled water	1 ounce	,,	1000 c. c.
	B.	Potassium hydrate	10 grains	or	23 grammes.
		Distilled water	1 ounce	,,	1000 c. c.

Equal parts of A and B.

With some plates the bromide may be omitted.

No. 3.	A.	Hydroquinone	80 grains	or	9 grammes.
		Citric acid	10 ,,	,,	1·4 ,,
		Sulphite of soda (recrystal.)	80 ,,	,,	9 ,,
		Distilled water	20 ounces	,,	1000 c. c.
	B.	Caustic potash (fused)	160 grains	or	18 grammes.
		Sulphite of soda	160 ,,	,,	18 ,,
		Distilled water	20 ounces	,,	1000 c. c.
	C.	Bromide of potassium	24 grains	or	55 grammes.
		Distilled water	1 ounce	,,	1000 c. c.
	D.	Caustic potash	160 grains	or	18 grammes.
		Distilled water	20 ounces	,,	1000 c. c.

For normal exposures use equal parts of A and B, adding five minims of C for every ounce of solution, or one per cent. of C.

For over-exposed plates use D instead of B, with an extra quantity of C.

For under-exposed plates omit C, and in extreme cases add six or eight grains more of sulphite of soda to each ounce of the developer. The object of increasing or decreasing the quantity of sulphite is to give greater or lesser density.

No. 4.	A.	Hydroquinone	160 grains	or	18 grammes.
		Sulphite of soda	2 ounces	,,	100 ,,
		Citric acid	60 grains	,,	7 ,,
		Bromide of ammonium	20 ,,	,,	2 ,,
		Water to	20 ounces	,,	1000 c. c.
	B.	Carbonate of potash	2 ounces	or	100 grammes.
		Carbonate of soda (crystal)	2 ,,	,,	100 ,,
		Water to	20 ,,	,,	1000 c. c.

Take equal parts.

The 'WELLINGTON'

Pink, Mauve,
White, and Matt.

P. O. P.

'ORDINARY,' for the Phosphate and Formate Toning Baths.

No. 5. A.	Hydroquinone	15 grains	or	7 grammes.
	Sulphite of soda	75 ,,	,,	35 ,,
	Water	5 ounces	,,	1000 c. c.
B.	Carbonate of potash	90 grains	or	41 grammes.
	Water	5 ounces	,,	1000 c. c.

C. Ten per cent. solution of bromide of potassium.

Use equal parts of A and B, and add two or three minims of C. With some plates no bromide restrainer will be required.

No. 6.	Sulphite of soda	40 grammes.
	Hydroquinone	5 ,,
	Carbonate of soda	75 ,,
	Water	200 c.c.

For use, dilute ten c.c. with water to thirty-five c.c.

For a single stock solution prepare as follows :—

No. 7. A.	Hydroquinone	50 grains	or	29 grammes.
	Metabisulphite of potash	80 ,,	,,	46 ,,
	Water	4 ounces	,,	1000 c. c.
B.	Carbonate of potash	840 grains	or	480 grammes.
	Water	4 ounces	,,	1000 c.c.

Filter solution B, and then mix A and B.

For use, take half an ounce of this solution and add to five ounces of water.

For Chloride Plates.

Hydroquinone	2 grains	or	4·5 grammes.
Sulphite of soda	10 ,,	,,	23 ,,
Carbonate of ammonia (or pot.)	10 ,,	,,	23 ,,
Bromide of potassium	$\frac{1}{10}$ grain	,,	0·3 ,,
Water	1 ounce	,,	1000 c. c.

DIPHENAL.

Diphenal, one of the recently introduced new developers, is chemically di-amido-oxydiphenyl, and it is the production of the Actien-Gesellschaft für Anilin-fabrikation, of Berlin. It is sent out in the form of a readily prepared solution of a brown colour, and the following are the directions for its use. For correctly exposed plates take :—

Diphenal	1 part.
Water	15 to 20 parts.

The 'WELLINGTON' P. O. P.

Gives a SUPERB Variety of Tones.

'SPECIAL,' for the Sulphocyanide Bath.

For over-exposed plates—

Diphenal	1 part.
Water	8 to 10 parts.

and for under-exposed plates take—

Diphenal	1 part.
Water	20 to 25 parts.

ACETONE PYRO-DEVELOPER.

Messrs. Lumière, who introduced acetone as a substitute for alkali in the pyro developer, recommend the following composition as the best for a normal developer:—

Water	100 parts.
Sulphite of sodium (anhydrous)	5 ,,
Acetone solution	10 ,,
Pyrogallic acid	1 part.

ORTOL.

1. Ortol Soda.

A.	Water, cold	10 ounces	or	1000	c. c.
	Metabisulphite of potash	35 grains	,,	7·5	grammes.
	Ortol	70 ,,	,,	15	,,
B.	Water	10 ounces	or	1000	c. c.
	Carbonate of soda, crystals	1¼ ,,	,,	120	grammes.
	Sulphite of sodium, crystals	1¾ ,,	,,	180	,,
	Bromide of potassium	5—10 grains	,,	1—2	,,
	Hypo solution, 5 : 100	50 minims	,,	10	c. c.

2. Ortol Potash.

A.	Water, cold	10 ounces	or	1000	c. c.
	Metabisulphite of potash	35 grains	,,	7·5	grammes.
	Ortol	70 ,,	,,	15	,,
B.	Water	10 ounces	or	1000	c. c.
	Carbonate of potash	½ ounce	,,	60	grammes.
	Sulphite of sodium, crystals	1¾ ounces	,,	180	,,
	Bromide of potassium	5—10 grains	,,	1—2	,,
	Hypo solution 5 : 100	50 minims	,,	10	c. c.

In cold weather the bromide of potassium may be left out.
For quick development take 1 part A and 1 part B.
For slow and soft development take 1 part A, 1 part B, 1 part water.

The 'WELLINGTON'

Platino=Matt Bromide.

Smooth, Rough, Cream Crayon, &c.

ADUROL.

I.—Separate Developer.

A.	Adurol	10 grammes	or 85 grains.
	Sulphite of sodium (cryst.)	80 ,,	,, 1¾ ounces.
	Water	500 c. c.	,, 10 ,,
B.	Carbonate of potash	60 grammes	or 1¼ ounces.
	Water	500 c. c.	,, 10 ,,

For studio work and snap-shots take 1 part of A, 1 part of B.

For time exposures outdoor take 1 part of A, 1 part of B, 1 part of water.

II.—One-solution (Concentrated) Developer.

Sulphite of sodium (cryst.)	200 grammes	or 4 ounces.
Carbonate of potash	150 ,,	,, 3 ,,
Water	500 c. c.	,, 10 ,,

After all having been dissolved,

Adurol	25 grammes	or ½ ounce.

For studio work and snap-shots take 1 part with 3 parts of water.

For time exposures outdoor take 1 part with 5 parts of water.

KACHIN.

A Single-solution Developer.

Water	200 grammes.
Sulphite of soda	5 ,,
Carbonate of soda (crystals)	10 ,,
Kachin	2 ,,

A Two-solution Developer.

A.	Water	250 grammes.
	Sulphite of soda	25 ,,
	Kachin	5 ,,
B.	Water	250 grammes.
	Caustic soda (pure sticks)	5 ,,
	Phosphate of soda	47 ,,

For use, mix 1 part of A with 1 part of B and 1 part of water.

The 'WELLINGTON'

Platino-Matt Bromide

For Enlargements.

IMOGEN-SULPHITE.

This new developing agent is said to be a mixture of well-known developers, and it is simple in use and works cleanly and with great brilliance.

A. Imogen-sulphite.........	1 ounce	or	83·3 grammes.
Warm distilled water	11 ounces	,,	1000 c. c.

B. Cold saturated solution, sodium carbonate.

For correctly exposed plates mix 2 parts of A with 1 part of B. For under-exposure or soft negatives mix 2 parts A, 1 part B, and 2 parts water. For over-exposure add from 5 to 50 drops of 10 per cent. solution of potassium bromide to every ounce of the developer. For very heavy contrasts use equal parts of A and B, and add to every ounce of developer 5 drops of 10 per cent. solution of potassium bromide.

DIOGEN.

Diogen is one of the latest developing agents, the composition of which is a secret. It gives a negative with good black colour and good gradation.

Sodium sulphite............	4 ounces	or	100 grammes.
Diogen........................	1 ounce	,,	24 ,,
Distilled water	10 ounces	,,	250 c. c.
Potassium carbonate......	5 ,,	,,	125 grammes.

For correct exposure mix :—

Concentrated solution ...	4 drachms	or	14 c. c.
Water	17 ,,	,,	60 ,,
Potassium bromide 10 per cent. solution	2 drops	,,	5 ,,

For under-exposure :—

Concentrated solution......	4 drachms	or	14 ,,
Water..........................	2–3 ounces	,,	60–90 ,,

For over-exposure :—

Concentrated solution......	4 drachms	or	14 ,,
Water..........................	1½–2 ounces	,,	25–60 ,,
Potassium bromide 10 per cent. solution	2–85 m.	,,	5–210 ,,

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The 'WELLINGTON'
FILMS.
For all Cameras, SHEATHS, &c.

PARAMIDOPHENOL.

Paramidophenol is the basis of rodinal and can be prepared either as a one or two-solution developer; the former when made with caustic alkalies is specially suitable for negative work, whilst the latter made with the carbonate alkalies is more suitable for positives.

Two-solution formula.

A.	Paramidophenol hydrochloride	$\frac{1}{2}$ ounce	or	20 grammes.
	Potassium metabisulphite	$\frac{1}{4}$,,	,,	10 ,,
	Water..............................	25 ounces	,,	1000 c. c.
B.	Sodium sulphite	$1\frac{1}{2}$ ounces	,,	60 grammes.
	Potassium carbonate	$1\frac{1}{2}$,,	,,	60 ,,
	Water..............................	25 ,,	,,	1000 c. c.

For use mix 1 part A with 2 parts B.

Single-solution.

Potassium metabisulphite	$\frac{3}{4}$ ounce	or	30 grammes.
Distilled water	$2\frac{1}{2}$ ounces	,,	100 c. c.
Paramidophenol	$\frac{1}{4}$ ounce	,,	10 grammes.

Stir the solution and add gradually

Saturated solution caustic soda *q.s.*

till the precipitate first formed is redissolved.

For use dilute with from 10 to 30 parts of water.

HYDROQUINONE, BR.

This developing agent is stated to be a chemical mixture of hydroquinone and a bromide, and whilst possessing all the advantages of hydroquinone, such as clear working, it does not give that harshness of contrast so characteristic of hydroquinone. It keeps well and does not stain.

A.	Hydroquinone Br.	$\frac{1}{2}$ ounce	or	10 grammes.
	Sodium sulphite	4 ounces	,,	80 ,,
	Water	25 ,,	,,	500 c. c.
B.	Potassium carbonate	3 ounces	,,	60 grammes.
	Water	25 ,,	,,	500 c. c.

For use mix 5 parts A, 5 parts B, and 4 parts water.

For over-exposure mix equal parts of A and B, and 20 to 30 drops of 10 per cent. bromide solution per ounce. For under-exposure mix equal parts A and B, and from 2 to 3 times the quantity of water.

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The 'WELLINGTON' Photographic

Papers and Films

Give SUPERB RESULTS.

THE GELATINO-CHLORIDE PROCESS.

BARKER'S FORMULA FOR PRINTING-OUT EMULSION.

Gelatine (Nelson's No. 1 and Coignet's, equal parts)	175 grains	or	80 grammes.
Chloride of ammonium.........	18 ,,	,,	8 ,,
Rochelle salts	50 ,,	,,	23 ,,
Nitrate of silver	75 ,,	,,	34 ,,
Alcohol	4 drachms	,,	100 c. c.
Water	5 ounces	,,	1000 ,,

Heat to 100° Fahr. (38° C.), and allow to remain at this temperature after all is dissolved for ten minutes, after which proceed in the usual way.

Toning Baths for the Foregoing.

Wash the prints in clean water and then *tone* in the following:—

1. A.	Distilled water	25 ounces	or	1000 c. c.
	Acetate of soda (recrystallised)	1 ounce	,,	40 grammes.
	Into which pour a solution of 1 per cent. of chloride of gold	2 ounces	,,	80 c. c.

B. In ten ounces (1000 c. c.) of distilled water, dissolve two drachms (25 grammes) of sulphocyanide of ammonium, and add one ounce (100 c. c.) solution of 1 per cent. chloride of gold.

For toning, mix in the proportion of twenty ounces of A to six of B. if possible the evening before using.

Another.

2. A.	Water	3 ounces	or	1000 c. c.
	Chloride of gold	2 grains	,,	1½ grammes.
B.	Water	3 ounces	or	1000 c. c.
	Sulphocyanide of ammonium ...	40 grains	,,	30 grammes.
	Hyposulphite of soda	1 grain	,,	0·8 ,,
	Carbonate of soda	3 grains	,,	2 ,,

These are mixed together by one part of A being poured into an equal part of B; in no case the reverse.

WELLINGTON & WARD,

ELSTREE, HERTS.

Manufacturers of { Platino-Matt Bromide,
P.O.P., Films, &c.

VALENTA'S FORMULA.

A.	Silver nitrate	480 grains or	32 grammes.
	Citric acid	120 ,, ,,	8 ,,
	Hot water	5¼ ounces ,,	160 c. c.
B.	Gelatine	1440 grains or	96 grammes.
	Ammonium chloride	42 ,, ,,	2·8 ,,
	Water	24·3 ounces ,,	700 c. c.
C.	Tartaric acid	42 grains or	2·8 grammes.
	Sodium bicarbonate	21 ,, ,,	1·4 ,,
	Alum	27 ,, ,,	1·8 ,,
	Water	5 ounces ,,	140 c. c.

Allow the gelatine to swell in the water and melt by the aid of heat and add the chloride. Mix B and C at 50° C., and in yellow light add A, heated to the same temperature, in small quantities, shaking thoroughly, and allow the emulsion to ripen for a short time at from 40° to 50° C. and then filter. For matt-surface papers the gelatine should be reduced to 754 grains or 80 grammes.

SOLIO COMBINED TONING AND FIXING BATH.

No. 1.

Hypo	20 ounces or	125 grammes.
Alum	5 ,, ,,	31 ,,
Soda sulphate	10 ,, ,,	62 ,,
Potash sulphate	2 ,, ,,	12 ,,
Water	160 ,, ,,	1000 c. c.

No. 2.

Gold chloride	15 grains or	4·3 grammes.
Lead acetate	64 ,, ,,	18 ,,
Water	8 ounces ,,	1000 c. c.

For use, eight parts of No. 1 solution; one part of No. 2.

A red precipitate is thrown down in the gold solution, but, if shaken before addition to the hypo, it will be redissolved.

The 'WELLINGTON' BRAND

Is a Guarantee of the

HIGHEST QUALITY.

Formula for Blue Tones.

No. 1.

Borax	600 grains	or	9	grammes.
Water	160 ounces	,,	1000	c. c.

No. 2.

Gold chloride	15 grains	or	2·3	grammes.
Water	15 ounces	,,	1000	c. c.

For use, eight parts of No. 1; half part of No. 2. The solutions must be kept separate.

A COMBINED TONING AND FIXING BATH.

Water	20	ounces	or	1000	c. c.
Hypo	5	,,	,,	250	grammes.
Citric acid	60	grains	,,	7	,,
Acetate of lead	60	,,	,,	7	,,
Sulphocyanide of ammonium	240	,,	,,	27	,,

These are added, and dissolved in the order given, and the solution allowed to stand for twenty-four hours. A precipitate will then be thrown down, and the clear solution decanted off. Then add—

Chloride of gold .... 3 grains or 3·4 grammes.

IMPERIAL P.O.P.

Directions for Use.

Hard negatives should be printed in strong light, delicate negatives only in the shade.

Prints should be rather darker than the finished picture is desired.

We specially recommend the following bath and mode of procedure for excellence and uniformity of result.

After printing, wash thoroughly for ten to fifteen minutes in running water before immersion in the Toning Solution.

In hot weather, if the surface of the prints become soft, immerse after washing, in an alum bath (alum 1 ounce, water 10 ounces), leave for ten minutes, wash again in running water for five to ten minutes and place in the following toning bath.

The 'WELLINGTON'
For Gaslight Development. S. C. P. (Slow Contact Paper.)
Prices same as **Wellington Platino=Matt Bromide.**

SULPHOCYANIDE TONING BATH.

Stock Gold Solution.

	Chloride of gold	15 grains	or	18 grammes.
	Water (distilled or boiled) to...	15 drachms	,,	1000 c. c.
No. 1.	Sulphocyanide of ammonium	75 grains	or	8·5 grammes.
	Water (boiled or distilled) to	20 ounces	,,	1000 c. c.
No. 2.	Stock gold solution	5 drachms	or	31 c. c.
	Water to	20 ounces	,,	1000 ,,

For use, take equal quantities of No. 1 and No. 2.

Add solution No. 2 slowly to solution No. 1, stirring all the time. Make up the solutions exactly as above, and follow out the instructions carefully.

The prints should tone in five to ten minutes.

When toning has been judged sufficient, wash for about five minutes and transfer to the following fixing bath :—

Hyposulphite of soda	3 ounces	or	150 grammes.
Water to	20 ,,	,,	1000 c. c.

After fixation is complete (about ten minutes), wash thoroughly for one hour.

THE SYLVIO PAPER.

WELLINGTON & WARD, ELSTREE, HERTS.

The phosphate toning bath is recommended :—

Phosphate of soda	40 grains	or	6 grammes.
Gold chloride	2 ,,	,,	0·3 ,,
Water	16 ounces	,,	1000 c. c.

The bath should be used as soon as it is mixed.

VELOX DEVELOPERS.

Metol Quinol.

Water	10 ounces	or	1000 c. c.
Metol	7 grains	,,	1·6 grammes.
Sodium sulphite, crystals pure...	½ ounce	,,	50 ,,
Hydroquinone	30 grains	,,	7 ,,
Sodium carbonate, desiccated*	200 ,,	,,	45 ,,

Ten per cent. bromide of potassium solution, about 10 drops.

The 'WELLINGTON'

For Gaslight Development. **S. C. P.** (Slow Contact Paper.)

Prices same as **Wellington Platino-Matt Bromide.**

Amidol.

Water	4 ounces	or	1000 c. c.
Sodium sulphite, crystals pure	200 grains	,,	114 grammes.
Amidol	20 ,,	,,	11 ,,

Ten per cent. bromide of potassium solution, about 5 drops.

Metol.

Water	10 ounces	or	1000 c. c.
Metol	25 grains	,,	5·7 grammes.
Sodium sulphite, crystals pure	½ ounce	,,	50 ,,
Sodium carbonate, desiccated*	120 grains	,,	27 ,,

Ten per cent. bromide of potassium solution, about 20 drops.

* If you use crystallised carbonate of sodium, take double this quantity.

Hypo Acid Fixing Bath.

Hypo	16 ounces	or	250 grammes.
Water	64 ,,	,,	1000 c. c.

Then add the following hardening solution:—

Water	14½ ounces	or	1000 c. c.
Sodium sulphite, crystals	1 ounce	,,	69 grammes.
Acetic acid, glacial acetic 51°	1½ ounces	,,	104 ,,
Powdered alum	1 ounce	,,	69 ,,

PAGET PRIZE GELATINO-CHLORIDE PRINTING-OUT PAPER.

ORDINARY OR MATT SURFACE.

Printing should be somewhat darker than the finished print is required.

It should be borne in mind, when toning, that the finished image will be bluer and slightly stronger when dry than in the wet state.

Toning.—The following bath is strongly recommended in preference to any other:—

Sulphocyanide of ammonia	30 grains	or	4 grammes.
Gold chloride	2½ ,,	,,	0·4 ,,
Water	16 ounces	,,	1000 c. c.

Before immersion in this toning bath, the prints should be *very thoroughly washed* for at least fifteen minutes in running water. This is necessary to ensure even toning.

The 'WELLINGTON'
For Gaslight Development.
S. C. P. (Slow Contact Paper.)
Prices same as **Wellington Platino-Matt Bromide.**

If the toning bath be found to tone too quickly, sulphite of soda equal in quantity to the gold used (*i.e.*, 2½ grains for above quantity) may be added. This will make the bath work more slowly, without making any other difference. More or less may be used so as to regulate to speed desired. The sulphite should be kept in a stock solution and added to the bath immediately before use.

In hot weather, if necessary, the print may be soaked in alum (alum, 4 ounces; water, 20 ounces) for five minutes before toning in this bath. Another thorough washing is necessary between the alum and toning baths.

MARIONA PAPER (P.O.P.).

Directions.—Print as with albumenised papers, slightly darker than required for the finished picture, or for partial development, as instructions below.

Washing.—After printing, wash thoroughly in several changes of water from ten to fifteen minutes.

Toning.—This paper may be toned with any of the usual baths, but the following are recommended:—

Platinum Toning.—For Sepia Tones.

Stock Solution.

A. Potassium chloro-platinite, 15 grains (2·3 grammes) in 15 ounces (1000 c. c.) of water, to which have been previously added 5 minims (½ c. c.) of hydrochloric acid.

B.			
Citric acid	160 grains	or	46 grammes.
Chloride sodium	160 ,,	,,	46 ,,
Water	8 ounces	,,	1000 c. c.

Take 2 ounces (60 c. c.) from A and 1 ounce (30 c. c.) from B, and make up to 1½ pints (900 c. c.) with water. This is sufficient for toning two sheets.

Gold Toning.—Carbonate Bath.

A. Stock solution of gold chloride, 15 grains tube in 15 ounces of water (2·3 grammes per litre).

B. Sodium carbonate (common washing soda), 30 grains in 15 ounces of water. (4½ grammes per litre.)

Take 2½ ounces (75 c. c.) each of A and B, and make up to 1 pint (600 c. c.). This should tone about 2½ sheets of paper.

The 'WELLINGTON'

For Gaslight Development. S. C. P. (Slow Contact Paper.)

Prices same as **Wellington Platino-Matt Bromide.**

Gold Toning.—Sulphocyanide Bath.

A. Stock solution of gold chloride, 15 grains in 15 ounces of water (2·3 grammes per litre).

B. Stock solution of ammonium sulphocyanide containing 15 grains to every ounce of water (35 grammes per litre).

For use, take 1 ounce (28 c. c.) each of A and B, and make up to 8 or 10 ounces (about 250 c. c.) with water, for each sheet of paper to be toned. The bath should be fresh every time.

Washing after Toning.—To be thoroughly washed in several changes of water, then placed in the fixing bath.

Fixing Bath.—Dissolve 3 ounces (150 grammes) of hypo in 1 pint of water (1000 c. c.). Keep the prints moving for at least 10 minutes.

Final Washing.—In running water, or several changes of water, for at least two hours.

Alum Bath.—In warm weather or hot climates it is advisable to use this bath before toning; strength about ten per cent, or chrome alum one per cent, for ten minutes, prints being again thoroughly washed before toning.

Partial Development.—This method will be found very convenient in dull weather, or even at night by magnesium or electric light. Print till the image is fairly visible, then immerse without washing in a ten per cent. solution of potassium bromide for four or five minutes. Then, after washing for a few minutes, place the print in the following developer mixed in equal proportions:—

A.	Hydroquinone	80 grains or	9 grammes.
	Sodium sulphite	320 ,, ,,	37 ,,
	Make up with distilled water to .	20 ounces ,,	1000 c. c.

B.	Sodium carbonate	400 grains or	460 grammes.
	Ammonium carbonate	400 ,, ,,	460 ,,
	Ammonium bromide	40 ,, ,,	46 ,,
	Make up with distilled water to .	2 ounces ,,	1000 c. c.

Continue the development until all but the faintest details are visible, then immediately wash the print thoroughly in running water to remove entirely the developer before placing it in the toning bath. All after-treatment will be the same as given above for printed-out prints.

The 'WELLINGTON'
P. O. P.
Gives Superb and Varying Tones. No Double Tones.

THE COLLODIO-CHLORIDE PROCESS.

PAGET PRIZE COLLODIO-CHLORIDE PRINTING-OUT PAPER.

Printing should be somewhat darker than the finished print is required; about the same as for our P.O.P., not quite so dark as for albumen.

Keeping.—Both the unprinted pieces of paper and the untoned prints are best kept in a cool place, closely packed together, flat, and under slight pressure. If left loosely exposed to the air, the collodion film may dry and harden, becoming more liable to crack during the toning and subsequent operations. Toning should be done as soon after printing as convenient; the same day, or, at farthest, the next day if possible.

Washing.—Before immersion in the toning bath, the prints should be *very thoroughly washed* for at least five minutes in running water or in three or four changes. If running water from a tap be used, it should not be turned on too violently, as it may tear or injure the film.

Alum.—After washing, it is strongly recommended that the prints be placed in an alum bath (alum, 4 ounces; water, 1 pint) for five minutes, and then washed for a quarter of an hour before toning. The alum has no action on the collodion film, but hardens the prepared paper underneath, and effectually prevents any softening or peeling in the subsequent operations. If the alum be well washed out, toning proceeds even more easily than if alum had not been used.

Toning.—Any of the ordinary toning baths employed for albumen or gelatine may be used, but no bath gives such rich, brilliant tones, either warm or cold, as the sulphocyanide. If a little care be taken to ensure clean dishes and clean fingers, there is no bath more simple or certain. We strongly recommend this bath in preference to any other.

Sulphocyanide of ammonia	30 grains	or	4 grammes.
Gold chloride	2 ,,	,,	0·3 ,,
Water	16 ounces	,,	1000 c.c.

Tone to exactly the colour desired, judging the prints as they lie in the dish; but it should be borne in mind that the finished image will be

The 'WELLINGTON'

P.O.P.

Gives Superb and Varying Tones. No Double Tones.

slightly bluer and stronger when dry than in the wet state. Wash and fix in

Hyposulphite of soda................	3 ounces or	150 grammes.
Water	1 pint ,,	1000 c. c.

If this bath be found to tone too quickly, sulphite of soda may be added at the rate of ¼ to ½ grain for every grain of gold used (say 1 grain for above quantity). This will make the bath work more slowly, without making any other difference. More or less may be used, so as to regulate to speed desired. The sulphite should be kept in a stock solution, and added to the bath immediately before use.

Allow at least ten minutes for fixing. Wash thoroughly in running water for at least an hour. Do not on any account wash longer than two hours; never leave in the water all night.

The prints may be damped off on blotting-paper and left to dry, or may be dried quickly in a moderate heat. They should *not* be left to dry *between* blotting-paper unless the latter is known to be pure. Impure blotting-paper makes spots and mottled marks on the prints.

THE ALBUMEN PROCESS.

PRESERVATIVES FOR SENSITISED ALBUMEN PAPER.

1.—Sensitise the paper in the usual bath, drain well, and when superficially dry float the back of the paper for twenty minutes on a solution of

Citric acid	1 ounce or	33 grammes.
Water	30 ounces ,,	1000 c. c.

Or,

2.—Sensitise as usual, drain well, and wash the paper in three or four changes of water, then float the back on a solution of

Nitrite of potassium	5 ounces or	50 grammes.
Water	100 ,, ,,	1000 c. c.

When dry, roll the paper up, coated side out, and wrap in blotting-paper soaked in the nitrite of potash solution, and dried.

The 'WELLINGTON'
S. C. P.
Gives Splendid Tones and Fine Gradation.

TONING FORMULÆ FOR ALBUMEN PRINTS.

No. 1.	Chloride of gold	1 grain	or	0·3 grammes.
	Acetate of soda	30 grains	,,	9 ,,
	Water	8 ounces	,,	1000 c. c.

This must not be used till one day after preparation. It keeps well, and gives warm, rich tones.

No. 2.	Chloride of gold	1 grain	or	0·3 grammes.
	Bicarbonate of soda	4 grains	,,	1 gramme.
	Water	8 ounces	,,	1000 c. c.

This is ready for immediate use after preparation, but it will not keep.

No. 3.	Chloride of gold	1 grain	or	0·3 grammes.
	Phosphate of soda	20 grains	,,	6 ,,
	Water	8 ounces	,,	1000 c. c.

This gives rich tones of a deep purple nature, but must be used soon after preparation.

No. 4.	Gold solution	10 drachms	or	63 c. c.
	Acetate of lime	20 grains	,,	2 grammes.
	Chloride of lime	1 grain	,,	0·1 ,,
	Tepid water	20 ounces	,,	1000 c. c.

The 'gold solution' before mentioned is prepared by neutralising as much as is required of a one-grain solution of chloride of gold by shaking it up with a little prepared chalk, then allowing it to settle, and filtering off the clear liquid. This toning bath improves by keeping. To use, add two ounces of it to eight ounces of tepid water, which will prove sufficient to tone a full-sized sheet of paper.

No. 5.	Chloride of gold	15 grains	or	7 grammes.
	Water................................	5 ounces	,,	1000 c. c.

Neutralise with lime water, make up to fifteen ounces (3000 c. c.) with water, and add two drachms (54 grammes) of chloride of calcium. This stock solution will keep for a long time for use. Dilute one ounce with ten ounces of water.

The 'WELLINGTON'
S. C. P.
Gives Splendid Tones and Fine Gradation.

TONING AND FIXING IN ONE BATH.

No. 6.	Chloride of gold	1 grain	or	1 gramme.
	Phosphate of soda	15 grains	,,	17 grammes.
	Sulphocyanide of ammonium	25 ,,	,,	28 ,,
	Hyposulphite of soda	240 ,,	,,	275 ,,
	Water	2 ounces	,,	1000 c. c.

Dissolve the gold separately in a small quantity of water, and add to the other solution.

INGALL'S TONING FORMULA.

Hard water (fluid)	20 ounces	or	1000 c. c.
Bi-carbonate of potash	20 grains	,,	2 grammes.
Gold	2 ,,	,,	0·2 ,,

NEGATIVE INTENSIFIERS.

MONCKHOVEN'S.

1. A.	Bromide of potassium	10 grains	or	23 grammes.
	Bichloride of mercury	10 ,,	,,	23 ,,
	Water	1 ounce	,,	1000 c. c.
B.	Pure cyanide of potassium	10 grains	or	23 grammes.
	Nitrate of silver	10 ,,	,,	23 ,,
	Water	1 ounce	,,	1000 c. c.

Place the negative in A till it is white, then rinse and transfer it to solution B. If the intensification has been carried too far, it may be reduced by treatment with a weak solution of hyposulphite of soda.

MERCURY AND AMMONIA.

Pour over the negative a saturated solution of mercuric chloride (bichloride of mercury); do not keep it on too long, unless the negative is very thin. Wash well, and immerse in bath of—

Water	10 ounces	or	1000 c. c.
Ammonia	10 minims	,,	21 ,,

Leave the plate in this solution until the black colour goes quite through the film.

The 'WELLINGTON'
Platino = Matt Bromide
IN THREE GRADES.
Smooth, Rough, & Cream Crayon.

MERCURY WITH SODIUM SULPHITE.

Whiten the negative in the saturated solution of mercuric chloride, wash and blacken with a solution of sulphite of sodium 1 in 5.

IODIDE OF MERCURY.

Dissolve one drachm (14 grammes) of bichloride of mercury in seven ounces (700 c. c.) of water, and three drachms (42 grammes) of iodide of potassium in three ounces (300 c. c.) of water, and pour the iodide solution into the mercury till the red precipitate formed is completely dissolved.

For use, dilute with water, flow over the negative till the proper density is reached, and wash, when the deposit will turn yellow. Remove the yellow colour by flowing a five per cent. solution of hypo over the plate, and give it the final washing.

URANIUM.

Uranium nitrate	12 grains or	7 grammes,
Potassium ferricyanide	15 ,, ,,	9 ,,
Water .... (fluid)	4 ounces ,,	1000 c. c.

Before using this intensifier, great care is necessary that every trace of hypo is dissolved from the film, or red fog will result.

FERRICYANIDE OF LEAD.

The negative, after washing, is placed in a solution made as follows :—

Lead nitrate	20 grains or	46 grammes,
Ferricyanide of potassium	30 ,, ,,	69 ,,
Distilled water	1 ounce ,,	1000 c. c.

After this it is again thoroughly washed until the drainings from the plate give a scarcely perceptible blue colour with ferrous-sulphate solution, and then ammonium sulphide (one part to ten parts of water) is poured over it.

BROMIDE OF COPPER.

A.	Potassium bromide	180 grains or	41 grammes.
	Water..................................	10 ounces ,,	1000 c. c.
B.	Cupric sulphate	240 grains or	55 grammes.
	Water..................................	10 ounces ,,	1000 c. c.

The 'WELLINGTON'
Enammo-Bromide
IN THREE COLOURS.
Rose, White, & Mauve.

Mix the solutions, and, after standing a few hours, decant or filter out any potassium sulphate that may be precipitated. The solution will keep indefinitely, and may be used over and over again.

The *modus operandi* of intensification is the same as with the mercuric salt. The darkening or rendering sufficiently opaque of the deposit can be done by a solution of ammonia in water—say, water, 10 ounces; stronger solution of ammonia, 1 drachm. The application of any old developer will bring about the same result.

LUMIÈRE'S MERCURIC IODIDE INTENSIFIER.

Composition of Normal Intensifier.

Water	100 parts.
Anhydrous sulphite of soda	10 ,,
Mercuric iodide	1 part.

Instructions for Use.—Dissolve the anhydrous sulphite of soda in the water, then add the mercuric iodide. After intensification in the above solution, the image is washed and then treated with an alkaline developer, such as is used for ordinary negative work.

NEGATIVE REDUCERS.

FARMER'S.

Saturated solution of ferridcyanide of potassium	1 part	or	100 c.c.
Hyposulphite of soda solution, 1:5.	10 parts	,,	1000 ,,

BELITZSKI'S.

Potassium ferric oxalate	154 grains	or	10 grammes.
Sodium sulphite	308 ,,	,,	20 ,,
Water	7 ounces	,,	200 c.c.

Dissolve and add

Oxalic acid (crystals) ......38–45 grains or 2·5 to 3 grammes,

and shake till the solution turns green, then decant from any undissolved crystals and add

Hyposulphite of soda .... 1½ ounces or 50 grammes.

The 'WELLINGTON'
Enammo-Bromide
IN THREE COLOURS.
Rose, White, & Mauve.

NAMIAS' POTASSIUM PERMANGANATE.

Potassium permanganate	8 grains	or	0·5 gramme.
Water	35 ounces	,,	1000 c. c.

Bathe the negative in this, and if it turns brown immerse in a 1 per cent. solution of oxalic acid, and wash and dry.

CYANIDE REDUCING SOLUTION.

Cyanide of potassium	20 grains	or	5 grammes.
Iodide of potassium	10 ,,	,,	2 ,,
Bichloride of mercury	10 ,,	,,	2 ,,
Water	10 ounces	,,	1000 c. c.

Reduction takes place slowly and is easy to control. After reducing, the negative should be washed thoroughly.

Perchloride of iron	30 grains	or	3·4 grammes.
Citric acid	60 ,,	,,	6·8 ,,
Water	1 pint	,,	1000 c. c.

ORTHOCHROMATIC PROCESSES.

F. E. IVES'S.

Use any good bromide collodion emulsion that contains no free nitrate of silver. Flow plate as usual, and, as soon as the emulsion film sets, flow several times with strong alcoholic solution of chlorophyl from blue myrtle or plantain leaves, then immerse in water strongly tinted with blue shade eosine, and keep in motion until smooth.

Sensitises for all colours, including deep ruby red. A very light yellow screen is sufficient to secure correct rendering of colour tone.

ILFORD PHOTOGRAPHIC GOODS.

POPULAR PRICES.

ALWAYS UNIFORM,
RELIABLE, PERFECT.

ILFORD, LIMITED, ILFORD, LONDON, E.

V. SCHUMANN'S (GELATINE PLATES).

Soak the plate in 200 c. c. of water and 2 to 4 c. c. of ammonia for two to three minutes, then immerse in

Distilled water	200 c. c.
Alcohol	10 ,,
Ammonia	4 ,,
Alcoholic solution of cyanine, 1 : 500	10 ,,

DRS. MALLMANN AND SCOLIK'S (GELATINE PLATES).

Preliminary Bath.

A. Water	200 c. c.
Ammonia	2 ,,

Soak the plate for two minutes.

Colour Bath.

Erythrosine solution, 1·1000	25 c. c.
Ammonia	4 ,,
Water	175 ,,

The plate should not remain longer in this bath than one and a quarter minute. A longer time depresses the general sensitiveness.

Alcohol	500 c. c.
Chinoline red	1 gramme.

To which are added 50 c. c. of a solution of—

Alcohol	500 c. c.
Chinoline blue (cyanine)	1 gramme.

OBERNETTER'S FORMULA.

Distilled water	480 c. c.	= 16 fluid ounces.
Nitrate of silver	1·25 gramme	= 18 grains.
Ammonium carbonate	5 ,,	= 75 ,,
Erythrosine solution (1 in 500)	35 c. c.	= 1⅛ fluid ounces.
Strong ammonia	4 c. c.	= 1 drachm.

Bathe the plate in the preliminary solution (Mallmann and Scolik's formula) for 150 seconds.

Without washing, flow the sensitising solution over the plate twice, and dry in the dark closet.

ILFORD PLATONA PAPER.

POPULAR PRICES.

GENUINE PLATINUM PAPER,
In Two Varieties, Rough and Smooth.

ILFORD, LIMITED, ILFORD, LONDON, E.

HYPO ELIMINATORS, CLEARING SOLUTIONS, &c.

TO RESTORE FADED NEGATIVES.

Mr. W. E. Debenham recommends the following solution for the purpose of restoring printing force to negatives which have faded after mercurial intensification:—

Schlippe's salt	10 grains or	23 grammes.
Water	1 ounce ,,	1000 c. c.

Wet the film thoroughly by soaking in a dish of water, and immerse in the restoring solution until the desired effect is obtained.

TO REMOVE THE LAST TRACES OF HYPO FROM THE FILM.

HYDROXYL.

Peroxide of hydrogen (twenty vols.) ...	1 drachm or	25 c. c.
Water	5 ounces ,,	1000 ,,

After washing the negative well it is immersed for a couple of minutes in the solution and again rinsed in water, when the intensification with silver can be at once proceeded with.

ANOTHER.

Where peroxide of hydrogen is not obtainable the following may be used as a substitute, the solution containing that substance in combination with others:—

Barium dioxide	1 ounce or	250 grammes.
Glacial acetic acid..........................	1 ,, ,,	250 ,,
Water	4 ounces ,,	1000 c. c.

Reduce the barium dioxide to a fine powder and add it gradually to the acid and water, shaking until dissolved. A few minutes' immersion in this solution will effectually remove or destroy the last traces of hypo.

ALUM.

A simple plan brought forward by Captain Abney for this specific purpose consists in employing a saturated solution of alum in place of the solution of hydroxyl or peroxide of hydrogen.

ILFORD ROUGH PLATONA PAPER.

POPULAR PRICES.

A GENUINE PLATINUM PAPER
For producing Beautiful Artistic Effects.

ILFORD, LIMITED, ILFORD, LONDON, E.

Eau de Javelle, or Labarraque's Solution.

Dry chloride of lime (hypochlorite of lime)	2 ounces or	50 grammes.
Carbonate of potash	4 ,, ,,	100 ,,
Water	40 ,, ,,	1000 c. c.

Mix the chloride of lime with thirty ounces of the water dissolve the carbonate of potash in the remainder. Mix, boil, and filter.

CLEARING SOLUTIONS.

Alum	2 ounces or	200 grammes.
Citric acid	1 ounce ,,	100 ,,
Water	10 ounces ,,	1000 c. c.

Wash moderately after fixing, and immerse the negative in the above.

Another.

Saturated solution of alum	20 ounces or	1000 c. c.
Hydrochloric acid (commercial)	1 ounce ,,	50 ,,

Immerse the negative after fixing, having previously washed it for two or three minutes under the tap; wash well after removal from the alum and acid.

NEGATIVE VARNISHES, FORMULÆ FOR.

No. 1.	Sandarac	4 ounces or	143 grammes.
	Alcohol	28 ,, ,,	1000 c. c.
	Oil of lavender	3 ,, ,,	107 ,,

This is a good varnish for retouching upon, as a 'tooth is easily obtained by rubbing.'

No. 2.	White hard varnish	15 ounces or	150 c. c.
	Methylated alcohol	20 to 30 ,, ,,	200 to 300 c. c.

This will be found a good and cheap varnish if durability is not required, as it is easily rubbed up for retouching upon and easily cleaned off. Very suitable for enlarged negatives that are not to be retained.

ILFORD BROMIDE PAPER.

POPULAR PRICES. SUPERB MATT SURFACE. SEE PRICE LIST FOR VARIETIES.

ILFORD, LIMITED, ILFORD, LONDON, E.

Tough, hard, and durable :—

No. 3.	Bleached shellac	1¼ ounce	or	62 grammes.
	Mastic	¼ ,,	,,	13 ,,
	Oil of turpentine	¼ ,,	,,	13 c. c.
	Sandarac	1¼ ,,	,,	62 grammes.
	Alcohol	20 fluid ounces	,,	1000 c. c.

No. 4.	Sandarac	80 ounces	or	160 grammes.
	Turpentine	36 ,,	,,	72 c. c.
	Oil of lavender	10 ,,	,,	20 ,,
	Alcohol	500 ,,	,,	1000 ,,

This one may be rubbed down with powdered resin, and gives a splendid surface for retouching :—

No. 5.	Sandarac	1 ounce	or	55 grammes.
	Seed lac	1½ ,,	,,	85 ,,
	Castor oil	3 drachms	,,	2 c. c.
	Oil of lavender	1½ drachm	,,	1 ,,
	Alcohol	18 fluid ounces	,,	1000 c. c.

This varnish is somewhat dark in colour.

No. 6.	Best orange shellac	2½ ounces	or	125 grammes.
	Oil of lavender or oil of turpentine	¼ ounce	,,	13 c. c.
	Methylated alcohol	1 pint	,,	1000 ,,

Keep in a warm place until dissolved; then add a large teaspoonful of whiting or prepared chalk; shake, set aside to clear, and then decant. This is specially recommended for gelatine negatives.

Retouching Varnish.

Sandarac	1 ounce	or	167 grammes.
Castor oil	80 grains	,,	31 ,,
Alcohol	6 ounces	,,	1000 c. c.

First dissolve the sandarac in the alcohol, and then add the oil.

In the above formulæ the proportions of alcohol must be taken as approximate, as different samples of resins vary, some giving more viscous solutions than others.

ILFORD P. O. P.

POPULAR PRICES.

AN EXQUISITE GELATINO-CHLORIDE PRINTING-OUT PAPER.

Used all over the World. See Price List for Varieties.

ILFORD, LIMITED, ILFORD, LONDON, E.

GROUND-GLASS VARNISH.

Sandarac	90 grains	or	103 grammes.
Mastic	20 ,,	,,	23 ,,
Ether	2 ounces	,,	1000 c. c.

Dissolve the resins in the ether and afterwards add

Benzole .... ½ to 1½ ounce (250 to 750 c. c.).

The proportion of the benzole added determines the nature of the matt obtained.

THE WET-COLLODION PROCESS.

PYROXYLINE (Hardwich).

Sulphuric acid 1·845	(fluid)	18 ounces	or	600 c. c.
Nitric acid 1·457	,,	6 ,,	,,	200 ,,
Water	(fluid)	5 to 5¼ ,,	,,	167 to 182 c. c.
Cotton-wool		300 grains	,,	23 grammes.

Temperature 150° Fahr. (66° C.) Time of immersion, 10 minutes.

IODISED COLLODION (for Negatives).

For Acid Pyro Developer.

Ether, s.g. ·725	10 fluid ounces	or	1000 c. c.
Alcohol, s.g. ·805	4 ,,	,,	400 ,,
Pyroxyline	120 grains	,,	27 grammes.
Iodide of ammonium	30 ,,	,,	7 ,,
,, cadmium	45 ,,	,,	10 ,,
Alcohol ·830	4 fluid ounces	,,	400 c. c.

BROMO-IODISED COLLODION (for Negatives).

Iron Developer.

Ether, s.g. ·725	10 fluid ounces	or	1000 c. c.
Alcohol, s.g. ·805	5 ,,	,,	500 ,,
Pyroxyline	120 grains	,,	27 grammes.
Iodide of ammonium	40 ,,	,,	9 ,,
,, cadmium	40 ,,	,,	9 ,,
Bromide of ,,	20 ,,	,,	4·5 ,,
Alcohol ·830	5 fluid ounces	,,	500 c. c.

ILFORD

POPULAR PRICES,

FOR ALL WHO TRAVEL.

Manipulated with ease in the same way as ILFORD PLATES. See Price List for Varieties.

ILFORD, LIMITED, ILFORD, LONDON, E.

Bromo-iodised Collodion (for Positives or Ferrotypes).

Ether, s.g. ·725	10 fluid ounces	or	1000 c. c.
Alcohol, s.g. ·805	5 ,,	,,	500 ,,
Pyroxyline	100 grains	,,	23 grammes.
Iodide of cadmium	50 ,,	,,	11½ ,,
Bromide of ammonium	25 ,,	,,	5·7 ,,
Alcohol ·830	5 fluid ounces	,,	500 c. c.

Note.—The iodides should be dissolved in the weaker spirit and the roxyline in the ether and stronger spirit, and the two solutions mixed.

The Nitrate Bath (for Negatives)

Nitrate of silver (recrystallised)	6 ounces	or	75 grammes.
Distilled water	80 fluid ounces	,,	1000 c c.
Nitric acid (pure)	8 minims	,,	0·2 ,,

Saturate with iodide of silver, then filter.

This is best done by coating a plate with collodion and leaving it in the bath for some hours.

(For Positives or Ferrotypes.)

Nitrate of silver (recrystallised)	5½ ounces	or	70 grammes.
Distilled water	80 fluid ounces	,,	1000 c c.
Nitric acid (pure)	½ drachm	,,	0·8 ,,

Saturate with iodide of silver and filter as above.

DEVELOPER.

For Negatives.

No. 1.	Ferrous sulphate	½ ounce	or	50 grammes.
	Glacial acetic acid	½ ,,	,,	50 c. c.
	Alcohol	½ ,,	,,	50 ,,
	Water	10 ounces	,,	1000 ,,
No. 2.	Ammonio-sulphate of iron	75 grains	or	43 grammes.
	Glacial acetic acid	75 ,,	,,	43 ,,
	Sulphate of copper	7 ,,	,,	4 ,,
	Water	4 ounces	,,	1000 c. c.
	Alcohol	¼ ounce	,,	60 ,,

ILFORD
'Special' and 'Alpha'
LANTERN
PLATES.

POPULAR PRICES.

SPECIAL FOR COLD TONES. ALPHA FOR A WIDE RANGE OF WARM TONES.

The Alpha Lantern Plate is the ONLY Plate of its kind.

ILFORD, LIMITED, ILFORD, LONDON, E.

For Collodion Positives or Ferrotypes.

Ferrous sulphate	150 grains	or	34 grammes.
Glacial acetic acid	½ ounce	,,	50 c. c
Nitric acid	5 minims	,,	1 ,,
Alcohol	½ ounce	,,	50 ,,
Water	10 ounces	,,	1000 ,,

Note.—By increasing the proportion of nitric acid and decreasing that of the acetic, the image will be more metallic in appearance.

Nitrate of Iron Developer for Positives.

Ferrous sulphate	1½ ounce	or	75 grammes.
Nitrate of baryta	1 ,,	,,	50 ,,
Water	1 pint	,,	1000 c. c.
Alcohol	1 ounce	,,	50 ,,
Nitric acid	40 drops	,,	4 ,,

The insoluble sulphate of baryta which is formed must be filtered out.

Fixing Solution for Positives.

Cyanide of potassium	½ ounce	or	25 to 30 grammes.
Water	15 to 20 ounces	,,	1000 c. c.

For Collodion Transfers.

Pyrogallic acid	5 grains	or	11 grammes.
Citric acid	3 ,,	,,	7 ,,
Acetic acid	20 minims	,,	41 c. c.
Water	1 ounce	,,	1000 ,,
Alcohol	20 minims	,,	41 c. c.

PYROXYLINE FOR DRY-COLLODION PROCESSES.

For Collodio-bromide or Unwashed Emulsion.

Nitric acid, s.g. 1·45	2 fluid ounces	or	285 c. c.
Sulphuric acid, s.g. 1·845	4 ,,	,,	570
Water	1 fluid ounce	,,	145 ,,
Cotton (cleaned and carded)	100 grains	,,	33 grammes.
Temperature	150° Fahr.	,,	65° C.
Time of immersion	10 minutes.		

ILFORD PROCESS AND HALF-TONE PLATES.

POPULAR PRICES.

INDISPENSABLE IN ALL PHOTO-MECHANICAL WORK.

ILFORD, LIMITED, ILFORD, LONDON, E.

For Washed Emulsion.

Nitric acid, s.g. 1·45	2 fluid ounces	or	400 c. c.
Sulphuric acid, s.g. 1·845	3 ,,	,,	600 ,,
White blotting-paper	145 grains	,,	66 grammes.
Temperature	100° Fahr.	,,	38° C.
Time of immersion	30 minutes.		

THE COLLODIO-BROMIDE PROCESS.

COLLODIO-BROMIDE EMULSION.

Ether, s.g. ·720	5 fluid ounce	or 620 c. c.
Alcohol, s.g. ·820	3 ,,	,, 380 ,,
Pyroxyline	50 grains	,, 14·3 grammes.
Bromide of cadmium and ammonium	80 ,,	,, 23 ,,
or Bromide of zinc	76 ,,	,, 21·5 ,,

Sensitise by adding to each ounce fifteen grains of nitrate of silver dissolved in a few drops of water and one drachm of boiling alcohol. This is suitable for slow landscape work or for transparencies.

Washed Emulsion (for Landscapes).

No. 1.

Ether, s.g. ·720	4 fluid ounces	or 590 c. c.
Alcohol, s.g. ·820	2¾ ,,	,, 410 ,,
Pyroxyline	40 grains	,, 13·5 grammes.
Castile soap (dissolved in alcohol)	30 ,,	,, 10 ,,
Bromide of ammonium and cadmium	84 ,,	,, 27·3 ,,

Sensitise with one hundred grains of nitrate of silver dissolved in one ounce of boiling alcohol; and, after standing ten days, add a further twenty grains of silver dissolved as before in two drachms of alcohol.

ILFORD SPECIAL RAPID PLATES.

POPULAR PRICES.
UNRIVALLED FOR SNAP-SHOTS.

ILFORD, LIMITED, ILFORD, LONDON, E.

No. 2 (rapid).

Ether, s.g. ·720	4 fluid ounces	or 615 c. c.
Alcohol, s.g. ·820	2½ ,,	,, 215 ,,
Pyroxyline	40 grains	,, 14 grammes.
Castile soap	30 ,,	,, 10·5 ,,
Bromide of ammonium and cadmium	56 ,,	,, 20 ,,

Sensitise with 125 grains of nitrate of silver, dissolved, as before, in one ounce of alcohol with the aid of heat. In twelve hours' time add thirty grains more of the double bromide of ammonium and cadmium dissolved in half an ounce of alcohol.

For Washed Emulsion (for Transparencies).

Ether, s.g. ·720	5 fluid ounces	or 620 c. c.
Alcohol, s.g. ·820	3 ,,	,, 380 ,,
Pyroxyline or papyroxyline	60 grains	,, 17 grammes.
Bromide of cadmium and ammonium	100 ,,	,, 29 ,,
or Bromide of zinc	96 ,,	,, 27·5 ,
Hydrochloric acid, s.g. 1·2	8 minims	,, 2 c. c.

Sensitise with twenty grains of nitrate of silver to each ounce (4·3 grammes to each 100 c.c.), dissolved in a minimum of water with two drachms (13 c.c.) of boiling alcohol. Allow to stand for two or three days.

N.B.—In the three last formulæ, the emulsion, after being allowed to ripen for the time stated, should be poured into a dish and allowed to become thoroughly dry. The mass of dry emulsion is then washed, to remove all the soluble salts, and is then again dried and redissolved in equal parts of ether and alcohol, at the rate of from twenty to twenty-four grains to the ounce of solvents.

DEVELOPING SOLUTIONS FOR COLLODION EMULSION.

Solution A.

Pyrogallic acid	96 grains	or 22 grammes.
Alcohol	1 fluid ounce	,, 100 c. c.

Solution B.

Bromide of potassium	10 grains	or 23 grammes.
Water	1 fluid ounce	,, 1000 c. c.

Solution C.

Liquor ammoniæ, s.g. ·880	1 fluid drachm	or 60 c. c.
Water	15 fluid drachms	,, 940 ,,

ILFORD CHROMATIC PLATES.

POPULAR PRICES.

FOR AUTUMN TINTS, for all Landscape Work at all Seasons for Copying and correct Colour Values in Monochrome.

A UNIQUE PLATE.

ILFORD, LIMITED, ILFORD, LONDON, E.

OR D.

Carbonate of ammonium	120 grains	or	275 grammes.
Water	1 fluid ounce	,,	1000 c. c.

For each drachm (100 c. c.) of developer take, for a normal exposure, five minims (8½ c. c.) of A, one or two minims (about 3 c. c.) of B, and the same of C; or, if D be used, add the above quantities of A, B, and C, to one drachm (100 c. c.) of D. When the details of the image are out, add double the quantities of B and C.

WELLINGTON'S COLLODIO-BROMIDE EMULSION FORMULÆ.

Pyroxyline	30 grains	or	23 grammes.
Ether	12 drachms	,,	500 c. c.
Alcohol	12 ,,	,,	500 ,,

To bromise, add 30 grains (23 grammes) bromide ammonium dissolved in 45 minims (31 c. c.) water, to which 4 drachms (170 c. c.) of alcohol are afterwards added; 50 grains (33 grammes) of nitrate of silver dissolved in a drachm (4½ c. c.) of water are then added. After washing and drying, the pellicle is dissolved in 1¾ ounces (580 c. c.) of ether and the same of alcohol.

DEVELOPER.

No. 1.	Pyrogallic acid	1 ounce	or	56 grammes.
	Sulphite of soda	4 ounces	,,	224 ,,
	Water	18 ,,	,,	1000 c. c.
No. 2.	Potassium carbonate	3 ounces	or	166 grammes.
	Sulphite of soda	2 ,,	,,	112 ,,
	Water	18 ,,	,,	1000 c. c.
No. 3.	Bromide ammonium	1 ounce	or	100 grammes.
	Water	10 ,,	,,	1000 c. c.

Use equal parts of each without dilution.

NESBIT'S FORMULÆ.

Pyroxyline	60 grains	or	27·5 grammes.
Methylated alcohol	2¾ ounces	,,	550 c. c.
Ether	2¼ ,,	,,	450 ,,
Bromide ammonium (in water 100 minims, 200 c.c.)	63 grains	,,	28 grammes.
Alcohol	1 ounce	,,	200 c. c.
Nitrate of silver.....................	100 grains	,,	46 grammes.
Water	60 minims	,,	25 c. c.

After washing and drying, redissolve in alcohol 4 ounces, ether 4 ounces (800 c. c.)

ILFORD ORDINARY PLATES.

POPULAR PRICES

FOR SUMMER, AND FOR ALL-ROUND WORK AT ALL TIMES.
BRILLIANT NEGATIVES EASILY PRODUCED.

ILFORD, LIMITED, ILFORD, LONDON, E.

INTENSIFYING SOLUTIONS FOR COLLODION EMULSION.

Nitrate of silver	60 grains	or	68 grammes.
Citric acid	30 ,,	,,	31 ,,
Nitric acid	30 minims	,,	31 c. c.
Water	2 ounces	,,	1000 ,,

To each drachm of a three-grain solution of pyrogallic acid add two or three minims of the above, and apply until sufficient density is attained.

MISCELLANEOUS FORMULÆ.

THE 'DUSTING-ON' PROCESS.

No. 1.	Saturated solution of bichromate of ammonium	5 drachms or grammes.
	Honey	3 ,, ,, ,,
	Albumen	3 ,, ,, ,,
	Distilled water	20 to 30 ,, ,, c.c.
No. 2.	Dextrine	½ ounce or 5 grammes.
	Grape sugar	½ ,, ,, ,,
	Bichromate	½ ,, ,, ,,
	Water	½ pint = 10 ounces or 100 c c.
No. 3.	Gum arabic	6 parts or grammes.
	Bichromate of potash	2·5 ,, ,, ,,
	Grape sugar	4 ,, ,, ,,
	Water	72 ,, ,, c.c.

SILVERING MIRRORS (MARTIN'S METHOD).

(*In employing the following formulæ, it should be well understood that the glass plate to be silvered must be scrupulously clean.*)

A.	Nitrate of silver	175 grains	or	40 grammes.
	Distilled water	10 ounces	,,	1000 c. c.

ILFORD
EMPRESS PLATES.

POPULAR PRICES.
FOR HAND CAMERA WORK. FINE GRAIN.
A PERFECT PLATE FOR THE STUDIO.

ILFORD, LIMITED, ILFORD, LONDON, E.

B.	Nitrate of ammonium	262 grains	or	60 grammes.
	Distilled water	10 ounces	,,	1000 c. c.
C.	*Pure* caustic potash	1 ounce	or	100 grammes.
	Distilled water	10 ounces	,,	1000 ,,
D.	Pure sugar candy	½ ounce (avoird.)	or	100 grammes.
	Distilled water	5 ounces	,,	1000 c. c.

Dissolve and add—

Tartaric acid 50 grains or 23 grammes.

Boil in a flask for ten minutes, and when cool add—

Alcohol 1 ounce or 200 c. c.

Distilled water *quant. suff.* to make up to 10 ounces or 2000 c. c.

For use take equal parts of A and B. Mix together also equal parts of C and D, and mix in another measure. Then mix both these mixtures together in the silvering vessel, and suspend the mirror face downward in the solution.

INK FOR RUBBER STAMPS.

Aniline red (violet)	90 grains	or	206 grammes.
Boiling distilled water	1 ounce	,,	1000 c. c.
Glycerine	half a teaspoonful	,,	60 ,,
Treacle	half as much as glycerine	,,	30 ,,

TO RECOVER FOGGED PLATES.

Make a solution as follows:—

Chromic acid	30 grains	or	7 grammes.
Bromide of potassium	60 ,,	,,	14 ,,
Water	10 ounces	,,	1000 c. c.

And immerse the plates for five minutes. Afterwards wash very thoroughly, and rear up to dry.

Or, instead of the above, make the following:—

Bichromate of potash	1 ounce	or	100 grammes.
Hydrobromic acid	2 drachms	,,	25 ,,
Water	10 ounces	,,	1000 c. c.

If hydrobromic cannot be obtained, use hydrochloric acid or a soluble bromide; in the last case a few drops of sulphuric acid being added to the solution. Use as before.

SOLUTION FOR MOUNTING PRINTS WITHOUT THEIR COCKLING.

Nelson's No. 1 photo. gelatine	4 ounces	or	182 grammes.
Water	16 ,,	,,	728 c. c.
Glycerine	1 ounce	,,	45 ,,
Methylated alcohol	5 ounces	,,	227 ,,

Dissolve the gelatine in the water, then add the glycerine, and lastly the spirit.

ENCAUSTIC PASTE.

Pure wax	500 parts or grammes.
Gum elemi	10 ,, ,, ,,
Benzole	200 ,, ,, c. c.
Essence of lavender	300 ,, ,, ,,
Oil of spike	15 ,, ,, ,,

BACKING SHEETS FOR DRY PLATES.

Gelatine	1 part	or 50 grammes.
Water	2 parts	,, 100 c. c.
Glycerine	1 part	,, 50 ,,
Indian ink	A small addition.	

Make a paste, and coat strong paper; place the prepared material, face downwards, on waxed glass to set. Press to back of plate before putting into dark slide.

SENSITISING SOLUTION FOR CARBON TISSUE.

Bichromate of potash	1 ounce	or 350 to 500 grammes.
Water	20 to 30 ounces	,, 1000 c. c.
Liquor ammoniæ	20 minims	,, 1·5 to 2 c. c.

A strong solution should be used for hard negatives and a more dilute one for soft negatives.

WAXING SOLUTION.

For Carbon Prints, or for Removing Collodion Films.

No. 1.	Beeswax	20 grains	or 10 grammes.
	Benzole rect. No. 1	4 ounces	,, 1000 c. c.

For Flexible Supports (Autotype).

No. 2.	Yellow resin	3 drachms	or 41 grammes.
	Yellow beeswax	1 drachm	,, 14 ,,
	Rectified spirits of turpentine	10 ounces	,, 1000 c. c.

ALBUMEN PROCESS FOR TRANSPARENCIES.

Iodised Albumen.

Albumen	10 ounces	or 1000 c. c.
Liquor ammoniæ	½ drachm	,, 6 ,,
Iodide of ammonium	50 grains	,, 11 grammes.
Bromide of ammonium	10 ,,	,, 2 ,,

Silver Bath.

Water	10 ounces	or 1000 c. c.
Nitrate silver	1 ounce	,, 100 grammes.
Glacial acetic acid	1 ,,	,, 100 ,,

Coat the glass with old iodised collodion and when it has set wash under the tap, drain, and coat with the albumen. When dry, sensitise for 1 minute, wash, and again dry.

Developer.

Pyrogallic acid	30 grains or	7 grammes.
Citric acid	20 ,, ,,	4·5 ,,
Water	10 ounces ,,	1000 c. c.

Use warm (120° Fahr. or 49° C.) and add 2 or 3 drops of a solution of 20-grain per ounce nitrate of silver (5 per cent.) at the time of using. Fix in a solution of hyposulphite of soda 4 ounces to the pint (20 per cent.). Tone with gold if the colour is too brown.

LUBRICANT FOR BURNISHING PRINTS.

Castile soap	20 grains or	4 grammes.
Alcohol	10 ounces ,,	1000 c. c.

BACKING FOR DRY PLATES TO PREVENT HALATION (TEAPE'S).

Gum solution (ordinary office gum)	1 ounce or part.
Caramel	1 ,, ,,
Burnt sienna, ground in water	2 ounces or parts.
Mix and add alcohol	2 ,, ,,

COLOUR FOR APPLYING TO BRIGHT MACHINERY PRIOR TO PHOTOGRAPHING IT.

Mix white lead with turpentine to the consistence of thin cream, with sufficient lamp-black to form a light slate colour, and then add one-sixth the bulk of japanners' gold size. Paint the machinery over with this. After the photograph has been taken, the colour can be quickly removed with a pledget of 'cotton waste' moistened with turpentine or benzoline.

RETOUCHING MEDIUM.

Pale resin	1 ounce or parts.
Oil of turpentine	1 ,, ,, ,,
Oil of lavender	2 ounces ,, ,,

TO PREVENT BLISTERS IN ALBUMEN PRINTS.

Before wetting the prints immerse them in methylated spirit, then wash and tone as usual.

STRIPPING THE FILMS FROM GELATINE NEGATIVES.

Soak the negative for ten minutes in a ten per cent. solution of formaline, then rinse and immerse in

Water	1 ounce or	500 c. c.
Methylated spirit	1 ,, ,,	500 ,,
Glycerine	20 m. ,,	20 ,,
Hydrofluoric acid	40 ,, ,,	40 ,,

till the film lifts at the corners, then strip from the glass and wash. This solution does not cause the film to enlarge.

PRINTING ON PLAIN PAPER.

Prepare the plain paper with

Ammonium chloride	60 to 80 grains	or 14 to 18 grammes.
Sodium citrate	100 ,,	,, 23 ,,
Sodium chloride	20 to 30 ,,	,, 5 to 7 ,,
Gelatine	10 ,,	,, 2 ,,
Distilled water	10 ounces	,, 1000 c c.

or, Ammonium chloride	100 grains	or 23 grammes.
Gelatine	10 ,,	,, 2 ,,
Water	10 ounces	,, 1000 c. c.

The gelatine is first swelled in cold water and then dissolved in hot water, and the remaining components of the formula are added. The solution is filtered, and, when still warm, the paper floated upon it for three minutes.

The salted paper is sensitised upon a neutral 45-grain silver bath.

PLATINUM TONING BATH FOR PLAIN SILVER PRINTS.

Chloroplatinite of potassium	1 gramme.
Water	1 litre.
Nitric acid	5 to 10 drops.

INVISIBLE INK.

Chloride of cobalt	50 grains	or 11 4 grammes.
Distilled water	1 fluid ounce	,, 1000 c. c.
Glycerine	10 minims	,, 21 ,,

Dissolve the chloride of cobalt in the distilled water, and add the glycerine.

Writing executed with this ink is invisible on paper, but, on warming, the writing turns blue. On exposure to damp air it becomes invisible again.

SOLUTION FOR MAKING PAPER ADHERE TO METAL.

Tragacanth	30 grammes.
Gum arabic	120 ,,
Water	500 c. c.

REDUCER FOR P.O.P. PRINTS.

Potassium Iodide	5 grains	or 5 grammes.
Sat. sol. of hypo	1 ounce	,, 500 c. c.
or Uranium nitrate	5 grains	,, 5 grammes.
Water	2 ounces	,, 1000 c. c.

FILM VARNISH.

Borax	300 grains or	30 grammes.
Glycerine	300 m. ,,	30 c. c.
Shellac	600 grains ,,	60 grammes.
Water	20 ounces ,,	1000 c. c.

Boil together for about half an hour, then add—

Methylated spirit	5 ounces ,,	250 c. c.

and filter.

DEXTRINE MOUNTANT.

White dextrine	90 grains or	90 grammes.
White sugar	15 ,, ,,	15 ,,
Carbolic acid	2 m. ,,	2 c. c.
Boiling water	¼ ounce ,,	1000 ,,

SEPIA TONES ON PLATINUM PAPER.

Prepare the following solutions:—

1.	Potassium oxalate	4 ounces or	250 grammes.
	Distilled water	16 ,, ,,	1000 c. c.
2.	Cupric chloride	124 grains or	61 grammes.
	Distilled water	8 ounces ,,	1000 c. c.
3.	Mercuric chloride	1 ounce or	62 grammes.
	Distilled water	16 ounces ,,	1000 c. c.
4.	Lead acetate	32 grains or	16 grammes.
	Distilled water	4 ounces ,,	1000 c. c.

Mix 12 parts of No. 1 with 4 parts No. 2, then add 4 parts No. 3 and 1 part No. 4, and heat till the precipitate first formed is redissolved. The solution should be heated to 80° C. and the prints developed in it in the usual way and treated to the usual acid clearing baths, and then immersed in strong ammonia 1 part, water 128 parts, for five minutes, and then washed and dried.

WATERPROOFING SOLUTION FOR WOOD.

Asphalt	4 ounces or	400 grammes.
Pure rubber	30 grains ,,	6 ,,
Mineral naphtha	10 ounces ,,	1000 c. c.

Apply with a stiff brush and give three successive coats, allowing to dry between each. The vapour of this is very inflammable.

TO BLACKEN ALUMINIUM.

Clean the metal thoroughly with fine emery powder, wash well and immerse in

Ferrous sulphate	1 ounce or	84 grammes.
White arsenic	1 ,, ,,	84 ,,
Hydrochloric acid	12 ounces ,,	1000 c. c.

Dissolve and add

Water	12 ounces or	1000 c. c.

When the colour is deep enough dry off with fine sawdust and lacquer.

DEAD BLACK FOR WOOD.

Borax	30	grains	or	7·5 grammes.
Glycerine	30	m.	,,	7·5 ,,
Shellac	60	grains	,,	15 ,,
Water	8	ounces	,,	1000 c. c.

Boil till dissolved and add

Nigrosine W.S.	60	grains	or	15 grammes.

or paint the wood first with

Cupric chloride	75	grains	or	75 grammes.
Potassium bichromate	75	,,	,,	75 ,,
Water	2¼	ounces	,,	1000 c. c.

and as soon as the surface dries apply

Aniline hydrochlorate	150	grains	or	150 grammes.
Water	2¼	ounces	,,	1000 c. c.

and wipe off any yellow powder that forms, and repeat the process till black enough, and then rub over with boiled linseed oil.

DEVELOPING FORMULÆ, ETC., OF THE PRINCIPAL PLATE AND PAPER MAKERS

AUSTIN EDWARDS'S FORMULÆ.

PYRO.

No. 1.	Pyrogallic acid	1 ounce or	12·5 grammes.
	Nitric acid	20 drops ,,	0·5 c. c.
	Water	8 ounces ,,	1000 ,,
No. 2.	Sulphite of soda	2½ ounces or	125 grammes.
	Carbonate of soda (crystals)	2¼ ,, ,,	113 ,,
	Potassium bromide	10 grains ,,	25 ,,
	Water	20 ounces ,,	1000 c. c.

Add the acid to the water before dissolving the pyro.

For correct exposure, use equal parts of Nos. 1 and 2.
For known over-exposure use 2 parts No. 1 and 1 part No. 2.

HYDROQUINONE.

No. 1.	Water	20 ounces or	1000 c. c.
	Hydroquinone	120 grains ,,	14 grammes.
	Sulphite soda	2 ounces ,,	100 ,,
No. 2.	Water	20 ounces or	1000 c. c.
	Carbonate of potash	4 ,, ,,	200 grammes.
	Bromide potassium	30 grains ,,	3·5 ,,

Dissolve the hydroquinone in the water before adding the sulphite. For use take equal parts of each.

HYDROQUINONE DEVELOPER FOR LANTERN PLATES.

(For Black Tones.)

Distilled water	20 ounces or	1000 c. c.
Hydroquinone	60 grains ,,	7 grammes.
Sulphite soda	2 ounces ,,	100 ,,
Carbonate soda (crystals)	6 ,, ,,	300 ,,
Bromide potassium	40 grains ,,	4·6 ,,

Dissolve the hydroquinone in the water and add the other ingredients in the order named.

Time of development, if exposed correctly, about 2 minutes. This developer may be used several times.

PYRO DEVELOPER.

(For Warm Tones.)

No 1.	Water	20 ounces or	1000 c. c.
	Nitric acid	20 drops ,,	2 ,,
	Sulphite soda	4 ounces ,,	200 grammes.
	Pyrogallic acid	1 ounce ,,	50 ,,

No. 2.	Water	20 ounces	or 1000 c. c.
	Bromide ammonium (not potass.)	3 ,,	,, 150 grammes.
	Liq. ammonia ·880	1 ounce	,, 50 ,,

Add the acid to the water, and the other ingredients in the order named.

For use, take 1 part each of Nos. 1 and 2, and dilute with equal quantities of water. For still warmer tones, add 1 part more water, or again double the exposure and add one-fourth more No. 2. This developer may be used several times.

CADETT & NEALL'S FORMULÆ.

Pyro Ammonia (1).

Stock Solution.

Pyrogallic acid	(avoirdupois) 1 ounce	or 136 grammes.
Ammonium bromide	,, ½ ,,	,, 68 ,,
Potass. metabisulphite	,, 1 ,,	,, 136 ,,

Distilled water to make altogether, 7 ounces, 3 drachms fluid, or 1000 c.c.

Dissolve the metabisulphite and bromide in part of the distilled water, before adding the pyrogallic acid.

A.	Stock solution	1 ounce	or 50 c.c.
	Distilled water to make altogether	20 ounces = 1 pint	,, 1000 ,,
B.	Ammonia (·890)	2½ drachms	or 16 c.c.
	Distilled water to make altogether	20 ounces = 1 pint	,, 1000 ,,

Mix equal parts of A and B to make developer.

Pyro Ammonia (2).

Stock Solution.

Pyrogallic acid	(avoirdupois) 1 ounce	or 136 grammes.
Ammonium bromide	,, 1 ,,	,, 136 ,,

Sulphurous or sulphuric or citric acid, 1 drachm,, 17 c. c. or grammes.

Distilled water to make altogether, 7 ounces, 3 drachms, fluid or 1000 c. c.

Mix the acid with part of the distilled water before adding the bromide and pyrogallic acid.

A.	Stock solution	1 ounce	or 50 c. c.
	Distilled water to make altogether	20 ounces = 1 pint	,, 1000 ,,
B.	Liq. ammoniæ (·890)	2½ drachms	or 16 c. c.
	Distilled water to make altogether	20 ounces = 1 pint	,, 1000 ,,

Mix equal parts of A and B to make developer.

Ferrous Oxalate.

A.	Ferrous sulphate	(avoirdupois) 5 ounces	or 250 grammes.
	Sulphuric acid	10 minims	,, 1 c. c.
	Distilled water to make altogether	20 ounces	or 1000 c. c.
B.	Neutral potass. oxalate	(avoirdupois) 10 ounces	or 250 grammes.
	Distilled water to make altogether (fluid)	40 ,,	,, 1000 c. c.

Dissolve the potass. oxalate in about three-quarters of the distilled water, made warm, and make up to bulk after the salt is dissolved.

The ferrous sulphate should be powdered just before solution in about three-quarters of the distilled water to which the sulphuric acid has been previously added. Make up to bulk after solution.

To make developer, add one part of A to four of B. For over-exposure, add a few drops to the mixed developer of a ten per cent. solution of potassium bromide.

PYRO SODA.

Stock Solution.

	Pyrogallic acid	(avoirdupois)	1 ounce	or	100 grammes.
	{ Potassium metabisulphite		40 grains	,,	9 ,,
	{ or sulphuric acid	(fluid)	1 drachm	,,	12 c. c.
	Distilled water to make altogether	,,	10 ounces	,,	1000 ,,
A.	Stock solution	(fluid)	3 ounces	or	150 c. c.
	Distilled water to make altogether	,,	20 ,,	,,	1000 ,,
B.	{ Sodium carbonate (crystals)	(avoird.)	11 ounces	or	138 grammes.
	{ or ditto ditto (anhydrous)	,,	4 ,,	,,	50 ,,
	Sodium sulphite (recrystd.)	,,	15 ,,	,,	188 ,,
	Distilled water to make altogether	,,	80 ,,	,,	1000 c. c.

Equal parts of each to make developer.

A few drops of a ten per cent. solution of potassium bromide may be added to the developer when necessary. In very hot weather the hypo bath should not be stronger than 1lb. of sodium hyposulphite to 2 quarts of water or twenty per cent.

DEVELOPERS FOR THE 'CADETT' LANTERN PLATES.

Warm Tones.—Pyro Ammonia.

A.	Pyrogallic acid	40 grains	or	5 grammes
	Ammonium bromide	40 ,,	,,	5 ,,
	Potass metabisulphite	120 ,,	,,	14 ,,
	Distilled water to make altogether (fluid)	20 ounces	,,	1000
B.	Liq. ammoniæ	150 minims	or	16 c. c.
	Distilled water to make altogether (fluid)	20 ounces	,,	1000 ,,

Equal parts of A and B to make developer.

This formula gives rich warm tones with suitable exposure.

For warm black tones, the following may be used:—

A.	Pyrogallic acid	30 grains	or	3·5 grammes.
	Sodium sulphite	100 ,,	,,	11 ,,
	Sulphurous acid (or citric acid 5 grains)	5 minims	,,	0·5 c. c.
	Ammonium bromide	30 grains	,,	3·5 grammes.
	Distilled water to make altogether ...	20 ounces	,,	1000 c. c.
B.	Liq. ammoniæ ·890	40 minims	or	4 c. c.
	Distilled water to make altogether (fluid)	20 ounces	,,	1000

Equal parts of A and B to make developer.

A rich warm black can be obtained with hydroquinone, and we strongly recommend the following formula:—

A.	Hydroquinone	70 grains	or	8 grammes.
	Potass metabisulphite	10 ,,	,,	1 ,,
	or sulphurous acid	15 minims	,,	1·5 c. c.
	Potassium bromide	35 grains	,,	4 grammes.
	Distilled water to make altogether (fluid)	20 ounces	,,	1000 c. c.
B.	Potassium hydrate (sticks)	140 grains	or	16 grammes.
	Sodium sulphite	700 ,,	,,	80 ,,
	Distilled water to make altogether	20 ounces	,,	1000 c. c.

Equal parts of A and B to make developer.

Black Tones.

Cold, but brilliant black tones are obtained with ferrous oxalate, adding a sufficient quantity of a 10 per cent. solution of potassium bromide to prevent too rapid development.

A.	Ferrous sulphate .... (avoirdupois)	5 ounces	or	250 grammes.
	Sulphuric acid	10 minims	,,	1 c. c.
	Distil. water to make altogether (avoird.)	20 ounces	,,	1000 ,,
B.	Neutral potass oxalate...... (avoirdupois)	10 ounces	,,	250 grammes.
	Distilled water to make altogether (fluid)	40 ,,	,,	1000 c. c.

Dissolve the potass oxalate in about ¾ of the distilled water, made warm, and make up to bulk after the salt is dissolved.

The ferrous sulphate should be powdered just before solution in about ¾ of the distilled water to which the sulphuric acid has been previously added. Make up to bulk after solution.

To make developer, add 1 part of A to 4 of B. For over-exposure add a few drops to the mixed developer of a 10 per cent. solution of potassium bromide.

THE KODAK COMPANY'S FORMULÆ.

For Bromide Paper.

No. 1.	Oxalate of potash	16 ounces	or	333 grammes.
	Hot water	48 ,,	,,	1000 c. c.
No. 2.	Proto-sulphate of iron	16 ounces	or	500 grammes.
	Hot water	32 ,,	,,	1000 c. c.
	Acetic acid	½ drachm	,,	2 ,,
	or,			
	Citric acid	½ ounce	,,	16 grammes.
No. 3.	Bromide of potassium	1 drachm	or	14 grammes.
	Water	10 ounces	,,	1000 c. c.

These solutions must be cooled and kept separately, and should be mixed only for immediate use.

To develop, take in a suitable tray, No. 1, 6 ounces, or 120 c. c., No. 2, 1 ounce, or 20 c. c.; No. 3, ½ drachm, or 1 c. c. Mix in the order given; use cold. After exposure, soak the paper in water until limp;

then immerse in the developer. The image should appear slowly, and should develop up strong, clear, and brilliant. When the shadows are sufficiently black, pour off the developer and flood the plate with the

Clearing Solution.

Acetic acid	1 drachm or	4 c. c.
Water	32 ounces ,,	1000 ,,

After fixing, wash thoroughly two hours, and hang up to dry. Use fresh developer for each batch of prints. With a glass-bottomed tray, eight ounces of developer are sufficient for a 25 × 30 print.

For Kodak Films.

No. 1.	Sulphite of soda	6 ounces or	188 grammes.
	Hot water	32 ,, ,,	1000 c. c.
	When cold, add—		
	Pyrogallic acid	1 ounce or	31 grammes.
No. 2.	Carbonate of soda	3 ounces or	94 grammes.
	Carbonate of potash	1 ounce ,,	31 ,,
	Water	32 ounces ,,	1000 c. c.

To develop, take, for normal exposures, one part each of No. 1 and No. 2, together with two parts of water.

Restrainer.

Bromide of potassium	1 ounce or	167 grammes.
Water	6 ounces ,,	1000 c. c.

If a number of films are fixed together in one tray, they should be put in *face down*, to avoid abrasion of the sensitive surface. It is well to move them about in the fixing bath, from time to time, in order to remove any air bubbles. After fixing, *wash thoroughly*; then immerse for one minute in the

Soaking Solution.

Water	16 ounces or	1000 c.c.
Glycerine	½ ounce ,,	31 ,,

Remove from the soaking solution, and pin up each film by *one* of its corners, to dry spontaneously. Any tear drops of the soaking solution should be removed with a bit of blotting-paper or absorbent cotton.

EDWARDS'S FORMULÆ.

Pyro and Ammonia Developer.

No. 1.	Pyrogallic acid	1 ounce or	30 grammes.
	Citric acid	40 grains ,,	3 ,,
	Water	7½ ounces ,,	214 c. c.
No 2.	Strong ammonia ·880	1 ounce or	28 c. c.
	Bromide of potassium	120 grains ,,	8 grammes.
	Distilled water	7 ounces ,,	200 c. c.

The above will keep good for months, if well corked.

For use, dilute 1 part No. 1 with 19 parts of water, and in another bottle 1 part No. 2 with 19 parts of water. The dilute solutions should be made fresh every day.

To develop a correctly exposed plate or film mix equal parts of these two solutions.

Pyro and Soda Developer.

No. 1.	Pyrogallic acid	1 ounce	or	30 grammes.
	Nitric acid	20 drops	,,	1 c. c.
	Water	80 ounces	,,	2 litres 300 c. c.
No. 2.	Sulphite of soda	10 ounces	or	300 grammes.
	Carbonate of soda (washing soda)	8 ,,	,,	226 ,,
	Water	80 ,,	,,	2 litres 300 c. c.
No. 3.	Bromide of potassium	1 ounce	or	30 grammes.
	Water	9 ounces	,,	250 c. c.

To develop, mix equal parts of Nos. 1 and 2, and add 10 minims of No. 3 to each ounce of the mixed developer, or, instead, 3 ounces of No. 3 may be added to the 80 ounces of No. 2. For rapid shutter exposures, omit the bromide.

Pyro and Soda Developer with Metabisulphite.

No. 1.	Pyrogallic acid	1 ounce	or	30 grammes.
	Metabisulphite of soda (Boake's)	1 ,,	,,	30 ,,
	Water	80 ounces	,,	2 litres 300 c. c.

Dissolve the metabisulphite, and then add the pyro.

No. 2.	Carbonate of soda (washing soda)	12 ounces	or	360 grammes.
	Sulphite of soda	4 ,,	,,	120 ,,
	Water	80 ,,	,,	2 litres 300 c. c.
No. 3.	Bromide of potassium	1 ounce	or	30 grammes.
	Water	9 ounces	,,	250 c. c.

To develop, mix equal parts of Nos. 1 and 2. When working in the summer time in a good light, with full exposure, add 5 minims of No. 3 to each ounce of developer (or to save the trouble of measuring small quantities, 1½ ounces of No. 3 may be added to the 80 ounces of No. 2). In winter the bromide may generally be omitted, and also for rapid shutter exposures, and portrait work in the studio.

Hydroquinone Developer.

No. 1.	Hydroquinone	¼ ounce	or	7 grammes.
	Sulphite of soda	1 ,,	,,	30 ,,
	Bromide of potassium	7 grains	,,	½ gramme.
	Distilled boiling water to make	12 ounces	,,	340 c. c.
No. 2.	Carbonate of potash	½ ounce	or	15 grammes.
	Distilled water to make	12 ounces	,,	340 c. c.

First dissolve the hydroquinone, and then add the sulphite and bromide.

For use mix equal parts of Nos. 1 and 2.

In case of slight over-exposure add a few drops or minims of a 10 per cent. solution of bromide of potassium to each ounce of developer, more or less according to the extent of over-exposure. For considerable over-exposure use the redeveloper.

For under-exposure, pour off the hydroquinone developer and finish development with the eikonogen developer given below.

EIKONOGEN DEVELOPER.

Eikonogen	½ ounce	or	14 grammes.
Carbonate of potash	1 ,,	,,	30 ,,
Sulphite of soda	2 ounces	,,	60 ,,
Distilled boiling water	20 ,,	,,	600 c. c.

First dissolve the eikonogen, then the sulphite, and lastly the carbonate of potash.

Instead of mixing the developers, the development may be commenced with eikonogen, and, when the detail is sufficiently out, hydroquinone substituted for it, without waiting to wash the negative, and the development finished with this, or in case of much over-exposure with the following hydroquinone redeveloper :—

HYDROQUINONE REDEVELOPER.

No. 1.	Hydroquinone	¼ ounce	or	7 grammes.
	Sulphite of soda	2 ounces	,,	60 ,,
	Bromide of potassium	¼ ounce	,,	7 ,,
	Distilled boiling water to make	12 ounces	,	340 c. c.
No. 2.	Carbonate of soda (washing soda)	2 ounces	or	60 grammes.
	Sulphite of soda	2 ,,	,,	60 ,,
	Distilled water to make	12 ,,	,,	340 c. c.

For use mix equal parts of Nos. 1 and 2.

EDWARDS'S GELATINO-CHLORIDE PLATES.

Development.

Make two stock solutions as follows :—

No. 1.	Neutral oxalate of potash	2 ounces	or	100 grammes.
	Chloride of ammonium	40 grains	,,	5 ,,
	Distilled water	20 ounces	,,	1000 c. c.
No. 2.	Sulphate of iron	4 drachms	or	25 grammes.
	Citric acid	2 ,,	,,	12·5 ,,
	Alum	2 ,,	,,	12·5 ,,
	Distilled water	20 ounces	,,	1000 c. c.

The above solutions will keep indefinitely.

When required for use, mix equal portions of the above solutions, adding No. 2 to No. 1, to form the developer.

EDWARDS'S SPECIAL TRANSPARENCY PLATES.

Pyro and Ammonia Developer.

Warm Tones.

No. 1.	Pyrogallic acid	1 ounce	or	30 grammes.
	Sulphite of soda	4 ounces	,,	120 ,,
	Citric acid	¼ ounce	,,	8 ,,
	Water to make	16 ounces	,,	460 c. c.

First dissolve the sulphite and citric acid, and then add the pyrogallic.

No. 2.	Bromide of ammonium.........	1 ounce	or	30 grammes.
	Liq. ammoniæ ·880	5½ drachms	,,	20 c. c.
	Water to make	16 ounces	,,	460 c. c.

For use, mix 1 part of No. 1 and 3 parts of No. 2, and dilute with water to double the quantity.

Hydroquinone Developer.

Black Tones.

Hydroquinone	60 grains	or	3 grammes.
Sulphite of soda.....................	2 ounces	,,	45 ,,
Carbonate of soda (crystals) ...	4 ,,	,,	90 ,,
Carbonate of potash	2 ,,	,,	45 ,,
Bromide of potassium	40 grains	,,	2 ,,
Hot distilled water	20 ounces	,,	450 c. c.

For black and white line subjects add 1 drachm of a 60-grain solution of bromide of potassium to each ounce of developer.

Dissolve the hydroquinone in the water, and add the other ingredients in the order named.

Amidol Developer.

Black Tones.

Amidol	80 grains	or	5 grammes.
Soda sulphite	2 ounces	,,	60 ,,
Bromide of potassium............	½ ounce	,,	15 ,,
Water..................................	12 ounces	,,	360 c. c.

ELLIOTT & SONS' FORMULÆ.

THE 'BARNET' PLATES, ORDINARY.

No. 1.	Ammonia (·880)	1½ ounce	or	75 c. c.
	Water	20 ounces	,,	1000 ,,
No. 2.	Pyrogallic acid......................	160 grains	or	18 grammes.
	Bromide of ammonium	¾ ounce	,,	38 ,,
	Water	20 ounces	,,	1000 c. c.
	Pure nitric acid	10 drops	,,	1 ,,

For use, mix ½ an ounce of No. 1, ½ an ounce of No, 2 with 3 ounces of water.

Pyro and Ammonia (10 *per cent. Solutions*).

No. 1.	Ammonia (·880)	1 ounce	or	100 c. c.
	Water	9 ounces	,,	900 ,,
No. 2.	Bromide of ammonium	1 ounce	or	100 grammes.
	Water, to make	10 ounces	,,	1000 c. c.
No. 3.	Pyro	1 ounce	or	100 grammes.
	Water, to make	10 ounces	,,	1000 c. c.
	Nitric acid, pure	20 drops	,,	4 ,,

For studio use, take 80 minims (10 c. c.) No. 1, 40 minims (5 c. c. No. 2, 20 minims (2½ c. c.) No. 3, and make up to 2 ounces (120 c. c.) with water.

The above developer is the same strength as that recommended on the boxes.

For outdoor work, take 80 minims No. 1, 60 minims No. 2, 40 minims No. 3, and make up to 2 ounces with water.

Pyro and Soda Developer.

Solution No. 1.

Pyro	1 ounce	or	12 grammes.
Water	86 ounces	,,	1000 c. c.
Nitric acid, pure	20 drops	,,	0·5 ,,

Solution No. 2.

Pure sulphite soda	10 ounces	or	116 grammes.
Pure carbonate soda (crystals)	9 ,,	,,	105 ,,
Water	86 ,,	,,	1000 c. c.

Use equal parts of Nos. 1 and 2, and dilute with equal bulk of water. To each ounce add 1 or 2 drops of a ten per cent. solution of bromide of potassium.

'BARNET' LANTERN TRANSPARENCY PLATES.

For Cold or Warm Tones (according to exposure and development).

INSTRUCTIONS FOR USE.

Contact Printing.—For black tones the exposure required is about 10 seconds at a distance of 1 foot from an ordinary gas flame: the developer to be used is either No. 1 or 2.

To secure warm tones it is necessary to increase the exposure to 2 or 3 minutes and use formula either No. 3 or 4.

To obtain still warmer (reddish) tones, increase the exposure still further to 5 or 6 minutes and develop with formula No 5.

Reductions in the Camera.—For black tones with stop *f*-16 in bright diffused light from a half-plate negative an exposure of about 10 seconds is required, using formula No 1 or 2 for developing.

For warm tones increase the exposure to 2 or 3 minutes and using for developer either formula No. 3 or 4.

For still warmer tones further increase the exposure to 5 or 6 minutes and develop with formula No. 5.

FORMULÆ FOR DEVELOPERS.

Note.—In cold weather all solutions should be raised to a temperature of 60°.

Cold Black Tones.

A.

No. 1.	Metol	400 grains	or	11 grammes.
	Soda sulphite	8 ounces	,,	100 ,,
	Water	80 ,,	,,	1000 c. c.

B.

Carbonate of potash	1200 grains	or	34 grammes.
Ammonium bromide	240 ,,	,,	7 ,,
Potassium bromide	480 ,,	,,	14 ,,
Water	80 ounces	,,	1000 ,,

Take equal parts of A and B.

Note.—The ammonium bromide is necessary for the production of absolutely cold black tones; a larger quantity is not recommended, as it tends to produce a slight veil in the high lights.

Length of time in developing about 2 minutes.

Warm Black Tones.

A.

No. 2. Hydroquinone	640 grains	or	18 grammes.
Soda sulphite	8 ounces	,,	100 ,,
Potass bromide	120 grains	,,	3 ,,
Water	80 ounces	,,	1000 c. c.

B.

Sodium hydrate	640 grains	or	18 grammes.
Water	80 ounces	,,	1000 c. c.

Take equal parts of A and B.

This produces a very pleasing warm black. Length of time in developing about 2 minutes.

Warm Brown Tones.

A.

No. 3. Pyro	1 ounce	or	12·5 grammes.
Soda sulphite	4 ounces	,,	50 ,,
Water	80 ,,	,,	1000 c. c.

B.

Carbonate of ammonia	900 grains	or	26 grammes.
Potassium hydrate	750 ,,	,,	21 ,,
Ammonium bromide	600 ,,	,,	17 ,,
Water	80 ounces	,,	1000 c. c.

Take equal parts of A and B.

Length of time in developing about 2 minutes.

Or the following may be used:—

No. 4.—Take equal parts of No. 2 formula and add to each ounce (100 c. c.) 3 grains (·6 gramme) each of carbonate of ammonia and ammonium bromide.

Length of time in developing about 3 or 4 minutes.

Very Warm (Reddish) Tones.

No. 5.—Take equal parts of No. 2 formula and add to each ounce (100 c. c.) 6 grains (1·2 gramme) each of carbonate of ammonia and ammonium bromide.

Length of time in developing about 8 minutes.

Fixing Bath.

We recommend the bath not to be made stronger than

Hypo	5 ounces	or	250 grammes.
Water	20 ,,	,,	1000 c. c.

Clearing solutions will not be found necessary with these plates.

BARNET BROMIDE PAPER.

(Extra Rapid.)

Platino Matt Surface.—Directions for Working.

Exposure.—For contact work from an average negative about 4 seconds, 18 inches from an ordinary gas burner.

For enlarging it is impossible to give any fixed data, so much depending upon the source of light. It is recommended to make a trial exposure upon a small piece of paper.

After exposure place the print, sensitive side upwards, in a clean developing dish, flood with water for a few seconds, drain off water, and then with one sweep cause the developer to flow evenly and quickly over the whole surface of the print.

Developers.—Ferrous-oxalate.

A.	Oxalate of potash	1 pound	or	333 grammes.
	Bromide potass	5 grains	,,	0·2 gramme.
	Hot water	48 ounces	,,	1000 c. c.
B.	Sulphate of iron	1 pound	or	500 grammes.
	Citric acid	½ ounce	,,	16 ,,
	Hot water	32 ounces	,,	1000 c. c.

Take 6 ounces of A and 1 ounce of B.

Immediately after developing, the print must be transferred straight into the acid bath.

Acetic acid	1 drachm	or	4 c. c.
Water	32 ounces	,,	1000 ,,

We strongly recommend the following

Metol Developer.

A.	Metol	400 grains	or	11 grammes.
	Sodium sulphite	8 ounces	,,	100 ,,
	Potass. bromide	50 grains	,,	1·4 ,,
	Water	80 ounces	,,	1000 c. c.
B.	Potass carbonate	8 ounces	or	100 grammes.
	Water	80 ,,	,,	1000 c. c.

Take 3 ounces of A and 1 ounce of B.

The image should appear in a few seconds, and development will be complete in about 2 minutes. Rinse in 3 changes of water and fix in fixing bath as above (no acid bath is necessary with this developer).

To produce softer results, either of the above may be diluted with an equal quantity of water.

After fixing, wash thoroughly in several changes of water for at least 2 hours, squeegee off the superfluous moisture, and hang up to dry.

THE EUROPEAN BLAIR CAMERA COMPANY'S FORMULÆ.

To develop the films soak in water first till limp.

Metol-Hydroquinone Developer.

Metol	75	grains	or	3·75 grammes.
Hydroquinone	100	,,	,,	5·0 ,,
Sodium sulphite	4	,,	,,	200 ,,
Sodium carbonate	2	ounces	,,	100 ,,
Water to	40	,,	,,	1000 c. c.

Ortol Developer.

1. Ortol	130	grains	or	15 grammes.
Potassium metabisulphite	65	ounces	,,	7·5 ,,
Water to	20	,,	,,	1000 c. c.
2. Sodium carbonate	2	,,	,,	100 grammes.
Potassium bromide	20	grains	,,	0·25 ,,
Sodium sulphite	2	ounces	,,	100 ,,
Water to	20	,,	,,	1000 c. c.

For use mix in equal parts.

In all cases of time exposures and for positive work add to the above developers potassium bromide ¼ grain per ounce, or 0·5 gramme per 1000 c. c.

As soon as sufficiently developed, rinse the film well in water and place in a fixing bath of

Hypo	4 ounces	or	250 grammes.
Sodium bisulphite	1 ounce	,,	62 ,,
Water to	20 ounces	,,	1000 c. c.

Do not expose to white light till thoroughly fixed.

FOR THE 'PREMIER' DRY PLATES.

Pyro-Soda Developer.

1. Pyrogallic acid	120	grains	or	12 grammes.
Sodium sulphite	2	ounces	,,	96 ,,
Potassium bromide	10	grains	,,	1 gramme.
Water	20	ounces	,,	1000 c. c.
2. Sodium Carbonate	2½	,,	,,	125 grammes.
Water	20	,,	,,	1000 c.c.

For use mix equal parts of 1 and 2. If the plate be under-exposed, add more of No. 2; if over-exposed, use less of No. 2 and more of No. 1.

Hydroquinone-Metol Developer.

1. Hydroquinone	50	grains	or	5 grammes.
Metol	50	,,	,,	5 ,,
Sodium sulphite	1	ounce	,,	50 ,,
Potassium bromide	20	grains	,,	2 ,,
Water	20	ounces	,,	1000 c. c.

2.	Sodium carbonate	2 ,,	,,	100 grammes.
	Water	20 ,,	,,	1000 c. c.

For use take equal parts of each. This developer can be used several times in succession.

Fixing Bath.

Hyposulphite soda	4 ounces.
Water	20 ,,

Allow the plates to remain in this bath for a minute or two after they seem fixed, and wash well.

GEM DRY PLATE COMPANY'S FORMULÆ.

Developer for Plates and Films.

No. 1.	Pyrogallic acid	1 ounce	or	20 grammes.
	Potassium bromide	60 grains	,,	3 ,,
	Sulphite of soda	6 ounces	,,	120 ,,
	Water to	50 ,,	,,	1000 c. c.
No. 2.	Washing soda	6 ounces	or	120 grammes.
	Water to	50 ,,	,,	1000 c. c.

For use, take equal quantities of No. 1 and No. 2.
For known under-exposure use an increased proportion of No. 2.
For known over-exposure use larger quantity of No. 1.

Alum Bath.

Alum	1 ounce	or	50 grammes.
Water	20 ounces	,,	1000 c. c.

Wash before and after immersing in the alum bath.

Fixing Solution.

Hypo	1 pound	or	250 grammes.
Water	64 ounces	,,	1000 c. c.

Lantern Plates.

Developer for Cold or Warm Tones.

(Cold Tones.)

Hydroquinone.

A.	Hydroquinone	½ ounce	or	25 grammes.
	Citric acid	¼ ,,	,,	12·5 ,,
	Potassium bromide	60 grains	,,	7 ,,
	Water	20 ounces	,,	1000 c. c.
B.	Caustic soda	½ ounce	or	25 grammes.
	Sodium sulphite	3 ounces	,,	150 ,,
	Water	20 ,,	,,	1000 c. c.

For use, take equal parts of A and B, and dilute with water equal to their combined bulk.

(Warm Tones.)

C. Ammonium carbonate	1 ounce	or	50 grammes.
Ammonium bromide	1 ,,	,,	50 ,,
Water	20 ounces	,,	1000 c. c.

For use, take of the above hydroquinone formula 2 parts, and add 1 part of C.

In obtaining either cold or warm tones, it is well to remember that exposure is the greatest factor. For cold tones, an exposure of 10 to 20 seconds, 1 foot from a No. 5 gas burner, will be ample, and develop as above. For warm and deeply coloured tones, expose from 30 seconds to 3 minutes, and develop with addition of C, always using a slightly increased proportion of C as the exposure is prolonged.

THE ILFORD FORMULÆ.

Stock Solutions.

A. Water	5½ ounces	or	550 c. c.
Nitric acid	20 minims	,,	1 ,,
Pyrogallic acid	1 ounce	,,	100 grammes.

This solution will keep good for several weeks.

Or B. Water	5½ ounces	or	550 c. c.
Potassium metabisulphite	70 grains	,,	15 grammes.
Pyrogallic acid	1 ounce	,,	100 ,,

This solution will keep good for several months.

Working Solutions.

No. 1.

Stock solution of pyro, A or B	1 to 2 ounces	or	100–200 c.c.
Water to make up to	20 ,,	,,	1000 ,,

No. 2.

Sodium carbonate, crystals (not bicarbonate) (avoirdupois)	2 ounces	or	100 grammes.
Sodium sulphite ,,	2 ,,	,,	1000 ,,
Potassium bromide	20 grains	,,	2 ,,
Water to make up to	20 ounces	,,	1000 c. c.

For normal exposures take equal quantities of Nos. 1 and 2.

The quantity of stock solution to be used must be regulated by the quality of negative desired. When a full quantity is used, the result is a slowing of the plate, and, at the same time, greater density or contrast of light and shade.

Pour the developer carefully over the plate, avoiding air bubbles, rock the dish, carefully keeping the plate well covered with solution. To obtain proper density, allow the plate to remain after all detail is out. Judge of this by looking through the plate.

To compensate for errors of exposure, the proportions of Nos. 1 and 2 can be varied thus; for under-exposure use more of No. 2 than of No. 1, and for over-exposure more of No. 1 than of No 2. It is a good plan, when there is a doubt as to the exposure being correct, to commence the development with twice the quantity of No. 1 than of No. 2, and add more of No. 2 if found desirable. To compensate for under-exposure, the mixed developer can also be diluted with water, of course allowing a longer time for its action.

Alum Bath.—After developing, wash the plate well under the tap, and immerse for a few minutes in alum, 1½ ounces; water, 20 ounces.

Fixing.—Wash well again, and fix as usual. Hyposulphite of soda, 1 pound; water, 40 ounces. Allow to remain in this bath for several minutes after fixation is apparently completed.

Never omit the alum bath in hot weather or under other conditions likely to produce frilling.

ILFORD P.O.P.

Working Instructions.

Printing.—This should be done in shade by preference, unless negatives are specially strong in contrast. The image loses very little depth in toning, &c.

First washing.—For 10 minutes in several changes.

Hardening Bath.—Soak the prints in

Alum	1 ounce,
Common salt	1 ,,
Water	20 ounces,

for 5 to 10 minutes, keeping them moving all the time.

Second washing.—For 10 minutes in several changes

Toning.—Any of the recognised formulæ for this class of paper may be used, but for simplicity and excellence of results we recommend the following. Make up the following stock solutions:—

No. 1.	Ammonium sulphocyanide	100 grains.
	Water	10 ounces.
No. 2.	Sodium sulphite	10 grains.
	Water	10 ounces.

This solution must be made up only on the day of using; any left over must be thrown away.

No. 3.	Gold chloride	15 grains.
	Water	15 ounces.

When mixing either of the following toning baths, bear in mind that this solution must be added last of all.

For the usual toning bath, take 2 ounces of each of Nos. 1 and 3 and make up to 20 ounces with water.

For the special toning bath, which is strongly recommended, take 2 ounces of each of Nos. 1, 2, and 3, and make up to 20 ounces with water.

Third washing.—For 5 minutes in several changes.

Fixing.—Use new solution for each batch of prints. The following is best strength :—

Hypo	3 ounces.
Water	20 ,,

Fixation is complete in about 10 minutes.

Final washing.—For at least 2 hours in running water, or many changes.

Mounting.—Mount with starch paste in the usual way. Prints thus treated and passed through roll give a fine glossy surface, better than albumen. This paper will also give prints of enamelled surface by squeegeeing down on glass in the usual way.

Special notes.—Do not use any excess of sulphocyanide or sulphite over the quantity mentioned.

Use the washing water and all solutions as cold as possible.

Keep the prints moving whilst in the various solutions.

ILFORD BROMIDE PAPER AND OPALS.

Development.—Make the following solutions and use when cold :—

No. 1.	Sulphate of iron	2½ ounces	or	250 grammes.
	Sulphuric acid	15 drops	,,	3 c. c.
	Warm water up to	10 ounces	,,	1000 ,,
No. 2.	Neutral potassium oxalate	10 ounces	or	250 grammes.
	Potassium bromide	20 grains	,,	1 gramme.
	Warm water up to	40 ounces	,,	1000 c. c.

For use, add 1 ounce No. 1 to 4 ounces No. 2, not *vice versâ.*

In cases of over-exposure or weak negatives, it is advisable to use half new and half old developer, to give greater brilliancy. Development is complete when image appears fully out. After development and without washing, immerse the prints for about 2 minutes in clearing solution, pour off and repeat.

Clearing Solution.

Water	80 ounces	or	1000 c. c.
Glacial acetic acid	½ ounce	,,	6·5 ,,

Then wash thoroughly for about 10 minutes in several changes of water. All the acid must be removed, or fading of prints will result.

Alternative Method of Development.

No. 1.	Metol	50 grains	or	5·0 grammes.
	Hydroquinone	25 ,,	,,	2·5 ,,
	Sodium sulphite	1 ounce	,,	50 grammes.
	Water up to	20 ounces	,,	1000 c c.
No. 2.	Sodium carbonate (crystals)	½ ounce	or	25 grammes.
	Potassium bromide	30 grains	,,	3 ,,
	Water up to	20 ounces	,,	1000 c. c.

Take equal quantities of No. 1 and No. 2.

It is important to note that no clearing solution is required with this developer.

Fixing.

Water	20 ounces	or 1000 c. c.
Hyposulphite of soda...... (avd.)	¼ pound	,, 200 ,,

Allow 15 minutes for thorough fixation. Use fresh solution for each batch of prints.

After fixing, wash for 2 hours in running water or in frequent changes. Allow prints to dry naturally. Work with clean hands and clean dishes.

ILFORD FORMULÆ IN METRIC MEASURES.

Ilford Plates.

Stock Solutions.

A.	Pyro	28·4 grammes (1 ounce).
	Nitric acid	20 drops.
	Water	150 c. c.
Or B.	Pyro	28·4 grammes.
	Potassium metabisulphite	5 ,,
	Water	150 c. c.

Working Solutions.

No. 1.	Stock solution of pyro A or B	25 to 50 c. c.
	Water to make up to	500 ,,
No. 2.	Sodium carbonate	50 grammes.
	Sodium sulphite	50 ,,
	Potassium bromide	1·2 ,,
	Water to make up to	500 c. c.

Alum Bath.

Alum	30 grammes.
Water	400 c. c.

Fixing.

Hypo	400 grammes.
Water	1000 c. c.

Ilford P.O.P.

Hardening Bath.

Alum	25 grammes.
Common salt	25 ,,
Water	500 c. c.

Toning.

No. 1.	Ammonium sulphocyanide	8 grammes.
	Water	350 c. c.
No. 2.	Sodium sulphite	0·8 gramme.
	Water	350 c. c.
No. 3.	Gold chloride (15 grain tube)	1 gramme.
	Water	425 c. c.

Fixing.

Hypo	75 grammes.
Water	500 c. c.

ILFORD BROMIDE PAPER AND OPALS.

Developer.

No 1.	Sulphate of iron	50 grammes.
	Sulphuric acid	10 drops.
	Warm water up to	200 c. c.
No. 2.	Potassium oxalate	200 grammes.
	Potassium bromide	1 gramme.
	Warm water up to	800 c. c.

Clearing Solution.

Glacial acetic acid	10 c. c.
Water	1600 ,,

Alternative Developer.

No. 1.	Metol	4 grammes.
	Hydroquinone	2 ,,
	Sodium sulphite	35 ,
	Water up to	700 c. c.
No. 2.	Sodium carbonate	17½ grammes.
	Potassium bromide	2·4 ,,
	Water up to	700 c. c.

Fixing.

Hypo	100 grammes.
Water	500 c. c.

PLATONA—ILFORD PLATINUM PAPER.

Printing.

Printing frame and pad should be quite dry.

Print until all details are faintly visible. Examine in weak light only.

Developing Formula—Stock Solution.

Potassium oxalate	2 ounces.
Potassium phosphate	½ ounce.
Water	14 ounces.

If unable to obtain potassium phosphate, the sodium phosphate may be substituted, but the former is preferable.

Dissolve the salts in hot water and allow to cool. This solution will keep indefinitely.

For use, take 1 part stock solution and 1 part water.

Develop in weak artificial or diffused light, floating prints face downwards in the solution. The image does not lose in fixing.

Fixing.

Pure hydrochloric acid	1 ounce.
Water	80 ounces.

Immerse prints for about 5 minutes each in three consecutive baths, and then give them a final washing in water for 15 minutes.

The prints are then ready to be dried and mounted.

Platona paper must be always kept stored in the tubes in which it is bought, and if so kept will remain in good condition. The cap should be kept screwed up, so that the tube is air-tight. Do not screw it up too hard, or it may be difficult to remove.

THE IMPERIAL COMPANY'S FORMULÆ.

'STANDARD' DEVELOPER.

No. 1.

Pyrogallic acid	55 grains	or	6 grammes.
Metol	45 ,,	,,	5 ,,
Metabisulphite of potash	120 ,,	,,	14 ,,
Bromide of potassium	20 ,,	,,	2 ,,
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

No. 2.

Carbonate of soda (washing soda)	4 ounces	or	200 grammes.
Water (boiled or distilled) to	20 ,,	,,	1000 c. c.

For use take equal parts of No. 1 and No. 2.

'UNIVERSAL' DEVELOPER.

No. 1.

Metol	40 grains	or	5 grammes.
Hydroquinone	50 ,,	,,	6 ,,
Sulphite of soda	120 ,,	,,	14 ,,
Bromide of potassium	15 ,,	,,	2 ,,
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

No. 2.

Caustic potash	180 grains	or	21 grammes.
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

For use take equal parts of No. 1 and No. 2.

'PYRO-SODA' DEVELOPER.

Stock Solution.

Pyrogallic acid	1 ounce	or	111 grammes.
Bromide of potassium	60 grains	,,	13 ,,
Metabisulphite of potash	50 ,,	,,	10 ,,
Water (boiled or distilled) to	12 ounces	,,	1000 c. c.

No 1.

Stock solution	3 ounces	or	150 c. c.
Water (boiled or distilled)	20 ,,	,,	1000 ,,

No. 2.

Sulphite of soda	2 ounces	or	100 grammes.
Carbonate of soda (washing soda)	2 ,,	,,	100 ,,
Water (boiled or distilled) to	20 ,,	,,	1000 c. c.

For use take equal parts of No. 1 and No. 2

'Imperial Metol' Developer.

No. 1.

Metol	100 grains	or	11·4 grammes.
Metabisulphite of potash	10 ,,	,,	1 ,,
Bromide of potassium	20 ,,	,,	2 ,,
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

No. 2.

Sulphite of soda	2 ounces	or	100 grammes.
Carbonate of soda	2 ,,	,,	100 ,,
Water (boiled or distilled) to	20 ,,	,,	1000 c. c.

For use take equal parts of No. 1 and No. 2.

'Hydroquinone' Developer.

No. 1.

Hydroquinone	150 grains	or	16 grammes.
Metabisulphite of potash	10 ,,	,,	1 ,,
Bromide of potassium	50 ,,	,,	6 ,,
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

No. 2.

Sulphite of soda	2 ounces	or	100 grammes.
Caustic soda	100 grains	,,	11 ,,
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

For use take equal parts of No. 1 and No. 2.

After using this developer, always rinse the negative well before transferring to the fixing-bath.

'Single-solution' Developer.

Metol	50 grains	or	5·5 grammes.
Hydroquinone	40 ,,	,,	4·5 ,,
Sulphite of soda	500 ,,	,,	57 ,,
Bromide of potassium	25 ,,	,,	3 ,,
Carbonate of soda	500 ,,	,,	57 ,,
Water (boiled or distilled) to	20 ounces	,,	1000 c. c.

Imperial 'Special' Lantern Plates.

For producing Transparencies of a Black Tone.

The exposure required for a negative of ordinary density will be about 5 seconds, at a distance of 24 inches from a medium-size gas-burner.

Developing formula (hydroquinone) is the same as that used with our ordinary plates

For development, use 1 part of No. 1 to 1 part of No. 2, and 1 part of water.

Metol developer is also excellent.

After development, the manipulations, washing, &c., will be the same as for negatives.

Imperial 'Slow' Lantern Plates.

For producing Transparencies of a Warm Tone.

The exposure required for a negative of ordinary density will be about 15 seconds, at a distance of 12 inches from a medium-size gas-burner.

Developing formula (hydroquinone) is the same as that used with 'special' lantern plates.

Imperial Bromide Opals.

Developers.

Metol. A.

No. 1.	Metol	50 grains	or	11·4 grammes.
	Dissolve in water	10 ounces	,,	1000 c. c.
	Then add soda sulphite	1 ounce	,,	100 grammes.
No. 2.	Soda carbonate (washing soda)	2 ounces	or	200 grammes.
	Water to	10 ,,	,,	1000 c. c.
No. 3.	Potassium bromide	½ ounce	or	50 grammes.
	Water to	10 ounces	,,	1000 c. c.

The developer for normal exposures to consist of 3 parts of No. 1 to 1 part of No. 2, to each ounce of which may, as a rule, be added 20 minims of No. 3.

Oxalate and Iron. B.

No. 1.	Potash oxalate	4 ounces	or	250 grammes.
	Water	16 ,,	,,	1000 c. c.
No. 2.	Iron sulphate	3 ounces	or	250 grammes.
	Water	12 ,,	,,	1000 c. c.
	Citric acid	50 grains	,,	9 grammes

Add 1 ounce of No. 2 to 5 ounces of No. 1; and to every ounce (30 c.c.) of developer add about 10 drops of a ten per cent. solution of potassium bromide.

No. 2 solution must always be added to No. 1 and not *vice versâ*.

MARION'S FORMULÆ.

For portraiture the following is recommended:—

Pyro Stock Solution.

Pyrogallic acid	1 ounce	or	50 grammes.
Sodium sulphite	4 ounces	,,	200 ,,
Sulphuric acid	1 drachm	,,	6 c. c.
Water to make up	20 ounces	,,	1000 ,,

Soda Stock Solution.

Sodium carbonate cryst	8 ounces	or	400 grammes.
Sodium sulphite	4 ,,	,,	200 ,,
Potassium bromide	1 drachm	,,	7 ,,
Water to make up	20 ounces	,,	1000 c. c.

For Development.

Five ounces of each stock solution made up separately to 20 ounces (1000 c. c.) with water and mixed in equal parts at the time of using. When very soft negatives are required—or only a minimum of exposure can be given—the bromide of potassium may be omitted.

PYRO-AMMONIA.

Pyrogallic acid........................	1 ounce	or	100 grammes.
Ammonium bromide	1 ,,	,,	100 ,,
Citric acid.................................	1 drachm	,,	14 ,,
Water to make up	10 ounces	,,	1000 c. c.

AMMONIA.

Strongest liquid ammonia ·880	2 ounces	or	200 grammes.
Water to make up	10 ,,	,,	1000 c. c.

Two ounces of each of above separately made with water to 20 ounces, (1000 c. c.) form the solutions for use, equal parts being mixed together at the time of development.

HYDROQUINONE DEVELOPER.

Hydroquinone Solution.

Hydroquinone	40 grains	or	9 grammes.
Sodium sulphite, pure	120 ,,	,,	27 ,,
Potassium brom.	5 ,,	,,	1 ,,
Citric acid.............................	5 ,,	,,	1 ,,
Water to make up to	10 ounces	,,	1000 c. c.

Alkali Solution.

Potass. hydrate, pure	120 grains	or	27 grammes.
Water to make up to	10 ounces	,,	1000 c. c.

This developer, mixed in equal proportions, will contain per ounce; Hydroquinone, 2 grains; sulphite, 6 grains; brom., ¼ grain; citric, ¼ grain; hydrate, 4 grains.

FOR GELATINO-CHLORIDE PLATES.

IRON.

For Cold Tones.

No. 1.	Potass. citrate	100 grains	or	230 grammes.
	Potass. oxalate	30 ,,	,,	69 ,,
	Hot distilled water to make up to	1 ounce	,,	1000 c. c.

For Warm Tones.

No. 2.	Citric acid	90 grains	or	206 grammes.
	Ammonium carbonate............	60 ,,	,,	137 ,,
	Cold distilled water to make up to	1 ounce	,,	1000 c. c.

For Extra Warm Tones.

No. 3.	Citric acid	130 grains	or	297 grammes.
	Ammonium carbonate	40 ,,	,,	92 ,,
	Cold distilled water to make up to	1 ounce	,,	1000 c. c.

In mixing the solutions Nos. 2 and 3, it is better to place the crystals of the salts into a deep vessel, and, after adding the water, leave alone till all effervescence ceases. It is advisable to make it over night.

To three parts of either of the above add one part of the following at the time of using :—

Sulphate of iron	120 grains	or	275 grammes.
Sulphuric acid	1 drop	,,	2 c. c.

Make up with distilled water to 1 ounce 1000 c. c.

Either of these developers should give clear glass in the unexposed parts of the picture; but, if at any time the slightest fog is found, it should at once be cured by the addition of a trace of either potassium bromide or sodium chloride. Bromide is better with No. 1, and chloride with either No. 2 or No. 3. A convenient form of using these will be to keep a ten per cent. solution of each of these salts, and one or two minims to each ounce of developer will be found a powerful restrainer.

Hydroquinone.

No. 1.	Hydroquinone	48 grains	or	11 grammes.
	Sodium sulphite	320 ,,	,,	73 ,,
	Ammonium bromide	2 ,,	,,	0·5 ,,
	Water to make up to	10 ounces	,,	1000 c. c
No. 2.	Ammonium carbonate	100 grains	or	23 grammes
	Sodium carbonate	100 ,,	,,	23 ,,
	Water to make up to	10 ounces	,,	1000 c. c.

Equal proportions of each are mixed together, according to size of plate to be developed at the time of using.

Different alkalies may be substituted for those mentioned, such as potassium carbonate, sodium silicate, potassium hydrate, sodium hydrate, &c.; but, in all cases, a small proportion of bromide should be used.

A number of plates may be developed one after the other in the same solution.

Eikonogen.

This developing agent, first introduced by us, will be found to give admirable results of a pleasing colour.

Formula.

Sulphite soda, pure	200 grains	or	46 grammes.
Eikonogen	50 ,,	,,	11 ,,
Potassium bromide	5 ,,	,,	1 ,,
Water to make up to	10 ounces	,,	1000 c. c.
Sodium carbonate	160 grains	or	37 grammes.
Water to make up to	10 ounces	,,	1000 c. c.

Equal parts to be mixed together at time of using.

For Chloro-bromide Plates

Pyrogallic Development.

A.	Pyrogallic acid	40 grains	or	9 grammes.
	Pure sodium sulphite	16 ,,	,,	4 ,,
	Citric acid	5 ,,	,,	1 ,,
	Water	10 ounces	,,	1000 c. c.

B. Liq. am. fort.	40 minims	or	8·3 c. c.
Potassium bromide	40 grains	,,	9 grammes.
Water to make up to	10 ounces	,,	1000 c. c.

Equal parts of the solutions to be mixed at the time of using.

A very pleasing warm colour will be obtained by adding to the B solution 200 grains (46 grammes) of ammonium carbonate, but the time of development will be increased

Ferrous-oxalate Development.

The saturated solutions of potassic oxalate and iron sulphate may be used in the proportion of three or four parts of the former to one of the latter, with the addition of one grain of potassium bromide to each ounce of developer, adding more bromide and increasing the amount of exposure when warmer tones are required.

To keep the iron solution from oxidising, one drop of sulphuric acid should be added to each ounce of water before dissolving the salt.

The ferrous-oxalate gives a blacker-coloured image than pyrogallic developer.

The time of development will vary from two to four minutes, according to temperature and density of image required.

Hydroquinone Developer.

Hydroquinone Solution.

Hydroquinone	40 grains	or	9 grammes.
Sodium sulphite, pure	120 ,,	,,	27 ,,
Potassium bromide	5 ,,	,,	1 ,,
Citric acid	5 ,,	,,	1 ,,
Water to make up to	10 ounces	,,	1000 c. c.

Alkali Solution.

Potassium hydrate, pure	80 grains	or	18 grammes.
Water to make up to	10 ounces	,,	1000 c. c.

Equal parts to be mixed together at time of using.

It is advisable that all solutions should be made with distilled water, though not absolutely essential.

Several plates may be developed in the same solution.

EIKONOGEN DEVELOPER

This developer will be found to suit these equally well with slight modification.

A small proportion of bromide must be used to ensure absolute clearness in the unexposed parts.

Formula.

Sodium sulphite	400 grains	or	91 grammes.
Potassium bromide	5 ,,	,,	1 ,,
Eikonogen	100 ,,	,,	23 ,,
Water to make up to	10 ounces	,,	1000 c. c.

Sodium carbonate	320 grains	or	73 grammes.
Water to make up to	10 ounces	,,	1000 c. c.

Equal parts of each to be mixed together at time of using.

FOR ARGENTIC BROMIDE OPALS.

Formula for Amidol Developers.

Amidol	20 grains	or	5 grammes.
Sodium sulphite	200 „	„	46 „
Potassium bromide	20 „	„	5 „

Made up to 10 ounces (1000 c. c.) with water.

Form the developer in one solution ready for use. Plates developed with this formula will not require the acid bath previous to fixing.

Formula for Eikonogen Developer.

Eikonogen	40 grains	or	9 grammes.
Sodium sulphite	160 „	„	37 „
Lithium carbonate	2 „	„	0·5 „
Water to make up to	10 ounces	„	1000 c. c.

This will keep for a considerable time if well corked.

One drop of a ten per cent. solution of potassium bromide may be added to each ounce of developer.

Plates developed with eikonogen will not require the acid bath previous to fixing.

MAWSON & SWAN'S FORMULÆ.

THE 'MAWSON,' 'ELECTRIC,' OR 'CASTLE' PLATE.

DEVELOPERS.

Pyro-ammonia Developer.

Stock Solution (ten per cent.).

Pyrogallic acid	480 grains	or	110 grammes.
Bromide of ammonium	240 „	„	55 „
*Metabisulphite of potassium	480 „	„	110 „
Distilled water to make up (fluid)	10 ounces	„	1000 c. c.

Dissolve the metabisulphite in part of the water, then add the other ingredients, and make up to bulk with water.

A.	Stock solution	300 minims	or	62 c. c.
	Distil. water to make up to (fluid)	10 ounces	„	1000 „
B.	Liq. ammoniæ ·880	70 minims	or	14·5 c. c.
	Distil. water to make up to (fluid)	10 ounces	„	1000 „

Use equal parts of A and B mixed at time of developing.

Pyro-soda Developer.

A.	Pyrogallic acid	60 grains	or	14 grammes.
	*Metabisulphite of potassium	15 „	„	3·5 „
	Distil. water to make up to (fluid)	10 ounces	„	1000 c. c.
B.	Washing soda	600 grains	or	137 grammes.
	Sulphite of soda	800 „	„	183 „
	Distil. water to make up to (fluid)	10 ounces	„	1000 c. c.

Use equal parts of A and B mixed at time of developing.

To correct errors in exposure :—If under-exposed, use a larger proportion of B ; if over-exposed, decrease the proportion of B, and add a few drops of a ten per cent. solution of bromide of potassium.

* Metabisulphite of potassium is unequalled as a preservative of pyrogallic acid in solution. If not at hand, substitute, for each grain of metabisulphite, sulphuric acid ½ minim *plus* sulphite of soda, 2½ grains.

Eikonogen Developer.

A.	Eikonogen	100 grains	or	23 grammes.
	Sulphite of soda (recrystd)	100 ,,	,,	23 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Carbonate of potassium (com.)	1200 grains	or	274 grammes.
	Sulphite of soda (recrystd.)	500 ,,	,,	114 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use 3 parts of A to 1 part of B, mixed at time of developing.

Hydroquinone Developer.

A.	Hydroquinone	40 grains	or	9 grammes.
	Metabisulphite of potassium	40 ,,	,,	9 ,,
	Bromide of potassium	5 ,,	,,	1 gramme.
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Caustic potass (sticks)	80 grains	or	18 grammes.
	Distil. water to make up to (fluid)	10 ounces	,,	1000 ,,

Use equal parts of A and B mixed at time of developing.

The Mawson Photo-mechanical Plate.

Developers.

Pyro-ammonia Developer.

A.	Pyrogallic acid	30 grains	or	7 grammes.
	Bromide of ammonium	30 ,,	,,	7 ,,
	Metabisulphite of potassium	30 ,,	,,	7 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Liq. ammoniæ ·880	70 minims	or	14·6 c. c.
	Distil. water to make up to (fluid)	10 ounces	,,	1000 ,,

Use equal parts of A and B mixed at time of developing.

Hydroquinone Developer.

A.	Hydroquinone	40 grains	or	9 grammes.
	Bromide of potassium	10 ,,	,,	2 ,,
	Metabisulphite of potassium	40 ,,	,,	9 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Caustic potass (sticks)	80 grains	or	18 grammes
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use equal parts of A and B mixed at time of developing.

THE MAWSON LANTERN PLATE.

Developers.

Exposure.—A negative of average density requires about 15 seconds at 1 foot from a No. 6 bat's-wing burner. Short exposure tends to produce black tones; long exposure, brown tones.

Either of the following developers may be used, though we give the preference to the pyro-ammonia, greater variety of tone being available by it.

Development begins rather slowly, especially with the hydroquinone formula, afterwards proceeding more rapidly.

Pyro-ammonia Developer.

A.	Pyrogallic acid	20 grains	or	5 grammes.
	Bromide of ammonia	20 ,,	,,	5 ,,
	Metabisulphite of potassium ...	50 ,,	,,	11 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Liq. ammoniæ ·880	70 minims	or	15 c c.
	Distil. water to make up to (fluid)	10 ounces	,,	1000 ,,

Use equal parts of A and B mixed at time of developing.

Hydroquinone Developer.

A.	Hydroquinone	40 grains	or	9 grammes.
	Bromide of potassium	40 ,,	,,	9 ,,
	Metabisulphite of potassium ...	40 ,,	,,	9 ,,
	Distil. water to make up to (fluid)	10 ounces		1000 ,,
B.	Caustic potass (sticks)............	80 grains	or	18 grammes.
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use equal parts of A and B mixed at time of developing.

Eikonogen Developer.

A.	Eikonogen..........................	100 grains	or	23 grammes.
	Bromide of potassium	20 ,,	,,	4·6 ,,
	Sulphite of sodium (recrystd.)	100 ,,	,,	23 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Washing soda	600 grains	or	137 grammes.
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use equal parts of A and B mixed at time of developing.

Ferrous-oxalate Developer.

A.	Neutral oxalate of potassium	1200 grains	or	274 grammes.
	Bromide of potassium	5 ,,	,,	1 ,,
	Citric acid	15 ,,	,,	3 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.
*B.	Ferrous sulphate	1600 grains	or	365 grammes.
	Citric acid	120 ,,	,,	27 ,,
	Distil. water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use 7 parts of A and 1 part of B, mixed at time of developing.

* Should this solution after keeping change to a brown colour, discard and mix afresh.

THE MAWSON OPAL PLATE.

Developer.

A.	Neutral oxalate of potassium	1200 grains	or	274 grammes.
	Bromide of potassium	5 ,,	,,	1 ,,
	Citric acid	15 ,,	,,	3 ,,
	Distilled water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Ferrous sulphate	1600 grains	or	365 grammes.
	Citric acid	120 ,,	,,	27 ,,
	Distilled water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use 7 parts of A and 1 part of B, mixed at the time of developing.

Should B, after keeping, change to a brown colour, discard and mix afresh.

THE MAWSON BROMIDE PAPER.

Developer.

A.	Neutral oxalate of potassium	1200 grains	or	274 grammes.
	Bromide of potassium	5 ,,	,,	1 gramme.
	Citric acid..................................	15 ,,	,,	3 grammes.
	Distilled water to make up to (fluid)	10 ounces	,,	1000 c. c.
B.	Ferrous sulphate	1600 grains	or	365 grammes.
	Citric acid	120 ,,	,,	27 ,,
	Distilled water to make up to (fluid)	10 ounces	,,	1000 c. c.

Use 7 parts of A and 1 part of B, mixed at the time of developing.

Should B, after keeping, change to a brown colour, discard and mix afresh.

THE PAGET PRIZE PLATE COMPANY'S FORMULÆ.

PYRO-AMMONIA.

No. 1.	Pyrogallic acid......................	1 ounce	or	50 grammes.
	Citric acid	60 grains	,,	7 ,,
	Sodium sulphite (pure)	2½ ounces	,,	125 ,,
	Distilled water to make	20 ,,	,,	1000 c. c.
No. 2.	Liq. ammoniæ ·880................	1 ounce	or	50 c. c.
	Ammonium bromide	80 grains	,,	9 grammes.
	(For Phœnix plates, 120 grains or 14 grammes.)			
	Distilled water to make	20 ounces	or	1000 c. c.

One part of each to 10 parts of water.

PYRO SODA.

No. 1.	Pyrogallic acid......................	¼ ounce	or	12·5 grammes.
	Sulphuric acid......................	5 drops	,,	0·5 c. c.
	Distilled water to make	20 ounces	,,	1000 ,,
No. 2.	Carbonate of soda (cryst. pure)	2 ounces	or	100 grammes.
	Sulphite of soda (pure)	2 ,,	,,	100 ,,
	Distilled water to make	20 ,,	,,	1000 c. c.

Equal parts of each

Hydroquinone.

No. 1.	Hydroquinone	1 ounce	or	50 grammes.
	Methylated spirit	10 ounces	,,	500 c. c.
	Sulphurous acid	½ ounce	,,	25 ,,
	Potassium bromide	¼ ,,	,,	12 grammes.

Dissolve the hydroquinone in the spirit, and add the acid. In another vessel dissolve the potassium bromide in 3 ounces (150 c. c.) of distilled water. Mix the two solutions, and make up to 20 ounces (1000 c. c.) with distilled water.

No 2.	Caustic soda (in sticks)	1 ounce	or	50 grammes.
	Sodium sulphite	5 ounces	,,	250 ,,
	Distilled water to make	20 ,,	,,	1000 c. c.

One part of each to 4 parts of water.

If this be found to give too hard a negative, use more water.

Eikonogen.

No. 1.	Eikonogen	½ ounce	or	17 grammes.
	Sodium sulphite	1½ ,,	,,	50 ,,
	Potassium bromide	8 grains	,,	0·6 gramme.
	Distilled water to make	30 ounces	,,	1000 c. c.

Sixty grains (5 grammes) hydroquinone added to above is a decided improvement, increasing brilliancy and density.

No. 2.	Potassium carbonate	1 ounce	or	100 grammes.
	Distilled water to make	10 ounces	,,	1000 ,,

Three parts of No. 1 to one part of No. 2.

Development.

For Black Tones any of the following formulæ are suitable :—

Pyro Ammonia.

Solution No. 1.

Pyrogallic acid	1 ounce	or	100 grammes.
Sodium sulphite	1½ ,,	,,	150 ,,
Citric acid	¼ ,,	,,	25 ,,
Distilled water to	10 ounces	,,	1000 c. c.

Solution No. 2.

Liquor ammoniæ, ·880	1 ounce	or	100 grammes.
Ammonium bromide	1 ,,	,,	100 ,,
Distilled water to	10 ounces	,,	1000 ,,

For use, take 45 minims (4·7 c. c.) of each solution and make up with water to 2 ounces (100 c. c.).

Ferrous-oxalate Developer.

Solution No. 1.

Neutral oxalate of potash	16 ounces	or	320 grammes.
Citric acid	60 grains	,,	3 ,,
Hot water	50 ounces	,,	1000 c. c.

Solution No. 2.

Protosulphate of iron	4 ounces	or	500 grammes.
Citric acid..............................	15 grains	,,	4 ,,
Hot water	8 ounces	,,	1000 c. c.

Solution No. 3.

Bromide of potassium	¼ ounce	or	25 grammes.
Water	10 ounces	,,	1000 c. c.

For development, take 6 ounces (60 c. c.) of No. 1 and add 1 ounce (10 c. c.) of No. 2 and 24 drops (½ c. c) of No. 3. Gives cold black tones.

Eikonogen Developer.

Solution No. 1.

Eikonogen	½ ounce	or	17 grammes.
Sodium sulphite	1½ ,,	,,	50 ,,
Potassium bromide....................	8 grains	,,	0·4 ,,
Distilled water to	30 ounces	,,	1000 c. c.

Solution No. 2.

Potassium carbonate	1 ounce	or	100 grammes.
Distilled water to	10 ounces	,,	1000 c. c.

Take three parts of No. 1 to one part of No. 2 solution.

Rodinal Developer.

Rodinal concentrated solution	1 part	or	33 c. c.
Water	30 parts	,,	1000 ,,

This is a very clean developer, and gives a rich black colour.

Hydroquinone.

Solution No. 1.

Hydroquinone.........................	½ ounce	or	25 grammes.
Sulphurous acid	¼ ,,	,,	12·5 c. c.
Potassium bromide..................	60 grains	,,	7 grammes.
Water to	20 ounces	,,	1000 c. c.

Solution No. 2.

Caustic soda	½ ounce	or	25 grammes.
Sodium sulphite......................	2½ ounces	,,	125 ,,
Water to	20 ,,	,,	1000 c. c.

For use, take ½ ounce (50 c. c.) of each to 1 ounce (100 c. c.) of water.

WARM TONES.—DEVELOPER

Solution No. 1.

Hydroquinone	½ ounce	or	25 grammes.
Sulphurous acid	¼ ,,	,,	12·5 ,,
Potassium bromide..................	60 grains	,,	7 ,,
Water to	20 ounces	,,	1000 c. c.

Solution No. 2.

Caustic soda	½ ounce	or	25 grammes.
Sodium sulphite	2½ ounces	,,	125 ,,
Water to	20 ,,	,,	1000 c. c.

Solution No. 3

Bromide of ammonium	1 ounce	or	50 grammes.
Carbonate of ammonium	1 ,,	,,	50 ,,
Water to	20 ounces	,,	1000 c. c.

Brown.

Exposure: 60 seconds 1 foot from gas-flame, or 2 inches of magnesium wire burnt at a distance of 3 feet. Developer: solution 1, ½ ounce (50 c. c.); solution 2, ½ ounce (50 c. c.); solution 3, 100 minims (20 c. c.); water to 2 ounces (200 c. c.). Time required in development, about 5 minutes.

Purple-brown.

Exposure: 90 seconds 1 foot from gas-flame, or 3 inches of magnesium wire burnt at a distance of 3 feet. Developer: solution 1, ½ ounce 50 c. c.); solution 2, ½ ounce (50 c. c.); solution 3, 200 minims (40 c. c.); water to 2 ounces (200 c. c.). Time required in development, about 10 minutes.

Purple.

Exposure: 3 minutes 1 foot from gas-flame, or 3 inches of magnesium wire burnt at a distance of 2 feet. Developer: solution 1, ½ ounce (50 c. c.); solution 2, ½ ounce (50 c. c.); solution 3, 250 minims (50 c. c.); water to 2 ounces (200 c. c.). Time required in development, about 12 minutes.

Red.

Exposure: 5 minutes 1 foot from gas-flame, or 5 inches of magnesium wire burnt at a distance of 2 feet. Developer: solution 1, ½ ounce (50 c. c.); solution 2, ½ ounce (50 c. c.); solution 3, 300 minims (60 c. c.); water to 2 ounces. Time required in development, about 15 minutes.

PRINTING-OUT OPALS AND LANTERN PLATES.

Combined Toning and Fixing Bath.

No. 1 Stock.

Hyposulphite of soda..............	20 ounces	or	125 grammes.
Alum (potash alum only)	5 ,,	,,	31 ,,
Sodium sulphate (not sulphite)...	14 ,,	,,	88 ,,
Water to	1 gallon	,,	1000 c. c.

Dissolve the hypo and alum each in about one quart (250 c. c.) of hot water, mix, and then add sodium sulphate already dissolved, making up to one gallon with remainder of water. This mixture should then be left for some hours for the precipitate to settle, when the clear solution may be poured off or filtered, and is then ready for use. It will keep indefinitely.

No. 2 Stock.

Gold chloride	15 grains	or	4 grammes.
Acetate of lead	64 ,,	,,	18 ,,
Water (distilled)	8 ounces	,,	1000 c. c.

Dissolve the acetate of lead in the water, and add the gold. A heavy precipitate forms in this solution, which should be shaken up when any is to be poured out: it redissolves when added to No. 1 stock solution. For use: Mix 8 oz. of No. 1 with 1 oz. of No. 2. When this bath is used, the prints should *not* be washed *before* toning.

Separate Toning Bath.

Sulphocyanide of ammonium	30 grains	or	4 grammes.
Gold chloride	2½ ,,	,,	0·4 ,,
Water	16 ounces	,,	1000 c. c.

BROMIDE OPALS.

Development.

For black tones the following developer is the one chiefly used:—

Ferrous-oxalate Developer.

Solution 1.

Neutral oxalate of potash	16 ounces	or	320 grammes.
Citric acid	60 grains	,,	3 ,,
Hot water	50 ounces	,,	1000 c. c.

Solution 2.

Protosulphate of iron	4 ounces	or	500 grammes.
Citric acid	¼ ounce	,,	31 ,,
(Or acetic acid, ½ drachm or 8 c. c.)			
Hot water	8 ounces	,,	1000 c. c.

Solution 3.

Bromide of potassium	¼ ounce	or	25 grammes.
Water	10 ounces	,,	1000 c. c.

For development take (when cold) 6 ounces (600 c. c.) of No. 1, and add 1 ounce (100 c. c.) of No. 2 and ½ drachm (6 c. c.) of No. 3.

For warm black tones use the hydroquinone developer, made up as follows:—

Hydroquinone Developer.

Solution 1.

Hydroquinone	½ ounce	or	10 grammes.
Sulphurous acid	¼ ,,	,,	5 ,,
Potassium bromide	60 grains	,,	3 ,,
Water to	50 ounces	,,	1000 c. c.

Solution 2.

Caustic soda	½ ounce	or	10 grammes.
Sodium sulphite	2½ ounces	,,	50 ,,
Water to	50 ,,	,,	1000 c. c.

For use take equal parts of the two solutions. By increasing the exposure and using less of No. 1 Solution, still browner images can be obtained. Other developers, such as eikonogen, pyro, rodinal, &c., can also be used.

ROUCH'S FORMULÆ.

A.	Pyrogallic acid	1 ounce	or 100 grammes.
	Sulphite of soda	4 ounces	,, 400 ,,
	Water, to make	10 ,,	,, 1000 c. c.

Dissolve the sulphite of soda in hot water, and, when cold, add the pyrogallic acid. Should any portion of the sulphite refuse to dissolve, the crystals may be allowed to remain in the bottle.

B.	Bromide of ammonium	1 ounce	or 100 grammes.
	Water, to make	10 ounces	,, 1000 c. c.

C.	Strongest liquor ammoniæ	3 ounces	or 300 c. c.
	Water, to make	10 ,,	,, 1000 ,,

In case sulphite of soda be not readily obtainable, the following may be substituted for solution A as above, and used in the same manner:—

Pyrogallic acid	1 ounce	or 100 grammes.
Citric acid	50 grains	,, 11 ,,
Water, to make	10 ounces	,, 1000 c. c.

Dissolve the citric acid first, and then add the pyro.

THE SANDELL WORKS COMPANY'S FORMULÆ.

A. Pyro Potash.

No. 1.	Pyro	1 ounce	or 28 grammes.
	Sulphite soda	3 ounces	,, 85 ,,
	Bromide potassium	¾ ,,	,, 21 ,,
	Citric acid	60 grains	,, 4 ,,
	Boiled or distilled water to	10 ounces	,, 300 c. c.

No. 2.	Carbonate potash	2 ounces	or 56 grammes.
	Sulphite soda	2 ,,	,, 85 ,,
	Boiled or distilled water to	10 ,,	,, 300 ,,

Hydroquinone Metol.

(For Black Tones.)

No. 1.	Hydroquinone	200 grains	or 13 grammes.
	Metol	20 ,,	,, 1·5 ,,
	Sulphite soda	3 ounces	,, 85 ,,
	Bromide potassium	30 grains	,, 2 ,,
	Citric acid	30 ,,	,, 2 ,,
	Boiled or distilled water to	20 ounces	,, 600 c. c.

No. 2.	Carbonate soda crystals	2 ounces	or 56 grammes.
	Caustic soda	60 grains	,, 4 ,,
	Boiled or distilled water to	20 ounces	,, 600 c. c.

C. Metol.

No. 1.	Metol	120 grains	or	8 grammes.
	Sulphite soda	2 ounces	,,	56 ,,
	Bromide potassium	129 grains	,,	8 ,,
	Boiled or distilled water to	20 ounces	,,	600 c. c.
No. 2.	Carbonate soda crystals	2 ounces	or	56 grammes.
	Boiled or distilled water to	20 ,,	,,	600 c. c.

Pyro Ammonia.

(For Warm Tones.)

No. 1.	Pyro	1 ounce	or	28 grammes.
	Sulphite soda	3 ounces	,,	85 ,,
	Citric acid	120 grains	,,	8 ,,
	Boiled or distilled water to	10 ounces	,,	300 c. c.
No. 2.	Liquid ammonia, ·880	1 ounce	or	30 c. c.
	Boiled or distilled water to	10 ounces	,,	300 ,,
No. 3.	Bromide ammonium	1 ounce	or	28 grammes.
	Boiled or distilled water to	10 ounces	,,	300 c. c.

THOMAS'S FORMULÆ.

Lantern or Transparency Plates.

Developing Formulæ.

Black Tones.

No. 1.	Hydroquinone	160 grains	or	10 grammes.
	Sodium sulphite	4 ounces	,,	110 ,,
	Citric acid	60 grains	,,	4 ,,
	Potassium bromide	160 ,,	,,	10 ,,
	Water to	20 ounces	,,	560 c.c.
No. 2.	Sodium hydrate	160 grains	or	10 grammes.
	Water to	20 ounces	,,	560 c.c.

Take equal parts of each solution, and development should be completed in three to four minutes. The plates should be somewhat overdeveloped, as they lose density in fixing.

Cold Tones.

No. 1.	Pyrogallic acid	1 ounce	or	28 grammes.
	Metabisulphite of soda	1 ,,	,,	28 ,,
	Water to	100 ounces	,,	2830 c. c.
No. 2.	Washing soda	6 ounces	or	170 grammes.
	Potassium bromide	20 grains	,,	1·3 ,,
	Water to	100 ounces	,,	2830 c. c.

Take equal parts of each solution, and development should be completed in five to seven minutes. Slightly over-develop to allow for loss in fixing.

Purple Tones.

No. 1.	Pyrogallic acid	1 ounce	or	28 grammes.
	Metabisulphite of soda	1 ,,	,,	28 ,,
	Water to	80 ounces	,,	2250 c. c.
No. 2.	Ammonium bromide	8 ounces	or	225 grammes.
	Liq, ammoniæ ·880	4 ,,	,,	110 c. c.
	Water to	80 ,,	,,	2250 ,,

Use equal parts of each solution.

This developer allows great latitude in exposure, and takes from three to twelve minutes to develop, according to the amount of exposure given.

When using this developer, the image will appear buried and lacking in density if examined by ruby light, but, when fixed, will be fully dense, and the deposit will appear opaque by reflected light, and purple by transmitted light, improving in colour when dry.

Fixing Bath.

Hyposulphite of soda	4 ounces	or	110 grammes.
Ten per cent. solution of metabisulphite of soda	1 ounce	,,	28 c. c.
Water to	20 ounces	,,	560 ,,

Pyro and Soda Developer.

No. 1.	Pyrogallic acid	1 ounce	or	12·5 grammes.
	Metabisulphite of soda	1 ,,	,,	12·5 ,,
	Water to	80 ounces	,,	1000 c. c.
No. 2.	Carbonate of soda (washing soda)	6 ounces	or	75 grammes.
	Water to	80 ,,	,,	1000 c. c.

For use, take equal parts of Nos. 1 and 2. For full exposure and in hot weather, 2 to 5 drops of a ten per cent. solution of potassium bromide may be added to each ounce. For under-exposure and isochromatic emulsions, this developer may be still further diluted.

Fixing Bath.

Hyposulphite of soda	1 pound	or	200 grammes.
Water to make	80 ounces	,,	1000 c. c.

WRATTEN & WAINWRIGHT'S FORMULÆ.

Developing Formulæ.

Ten per cent. Pyro and Ammonia.

A.	Liquor ammoniæ	1 ounce	or	100 c. c.
	Bromide potassium	110 grains	,,	22 grammes.
	Water	10 ounces	,,	1000 c c.
B.	Pyro	1 ounce	or	100 grammes.
	Citric acid	60 grains	,,	12 ,,
	or sulphuric acid	½ drachm	,,	6 c. c.
	Water	10 ounces	,,	1000 c. c.

For Instantaneous and Ordinary take from 60 (3 c. c.) to 90 minims (5 c. c.) and for Drop Shutter 90 minims (5 c. c.) of Solution B, dilute with from 2 to 4 ounces (60 to 120 c. c) of water, and add 100 minims (6 c. c.) of Solution A.

It is better to add Solution A by instalments as development proceeds, unless the exposure is known to be either insufficient or quite accurate, in which cases it may be added in one quantity.

The addition of 2 ounces (200 grammes) sulphite of soda to Solution B retards discolouration and improves the tone of the negative, but slightly prolongs the operation of development.

Pyro Soda.

We recommend this developer for studio and hand-camera work.

No. 1.	Sulphite soda	6 ounces	or	75 grammes.
	Water	80 ,,	,,	1000 c. c.
	Sulphuric acid or citric acid	1 drachm	,,	1·5 ,,
	Pyro	1 ounce	,,	13 grammes
No. 2.	Soda carbonate	6 ounces	,,	75 ,,
	Water	80 ,,	,,	1000 c. c.

For use, take equal parts of Nos. 1 and 2.

The best printing results in hand-camera work may be obtained by developing with the above developer or the pyro acetone, and diluting with from 1 to 1½ times its bulk with water. Time from 10 to 20 minutes; without dilution, 3 to 5 minutes.

Metol.

A.	Metol	50 grains	or	10 grammes.
	Water	10 ounces	,,	1000 c. c.
	When dissolved, add			
	Soda sulphite	1 ounce	,,	100 grammes.
B.	Soda carbonate	2 ounces	or	200 grammes.
	Or potass. carbonate	1 ounce	,,	100 ,,
	Water	10 ounces	,,	1000 c. c.

C. *Ten per cent. Potass. Bromide Solution.*

Potass. bromide	1 ounce or 100 grammes.
Water	10 ounces ,, 1000 c. c.

Mix 3 parts A with 1 part B, dilute with an equal bulk of water, and add 20 minims (1·5 c. c.) ten per cent. bromide solution C.

If more density and contrast be required, use the solution more concentrated, dilution giving softness according to its degree.

PYRO ACETONE.

No. 1.—Same as pyro soda No. 1.

No. 2.—Acetone, 10 ounces or 250 c. c.; water, 40 ounces or 1000 c. c.

For use, take equal parts Nos. 1 and 2; or, for more contrast, No. 1, 2 parts; No. 2, 1 part.

For over-exposure add ten per cent. bromide solution from 5 minims (·3 c. c.) upwards according to necessity.

For use with the London Drop-shutter Special always add 5 minims (·3 c. c.) of ten per cent. bromide solution *before* application.

This developer gives reddish-brown tones, is controllable by the addition of bromide, produces a good even printing density, and is excellent for under-exposure.

The total time of development is about the same as with pyro soda, although the image makes a quicker appearance.

It does not soil the hands.

Rodinal used in the proportion of 1 to 25 yields brilliant results, its applicability is very comprehensive, suiting nearly all subjects.

Temperature of water and solutions should be about 60° F. or 15 C.

Fixing.—Either a plain A or an acid B fixing bath may be used, giving a brown or a blackish tint respectively after pyro-ammonia development.

A.	Hyposulphite soda	4 ounces or 200 grammes.
	Water	20 ,, ,, 1000 c. c.
B.	Hyposulphite soda	5 ounces or 250 grammes.
	Water	20 ,, ,, 1000 c. c.
	Sulphite soda	1 ounce ,, 50 grammes.
	When dissolved, add slowly, stirring all the time,	
	Sulphuric acid	1 drachm or 6 c. c.

Formalin will be found very useful during hot or thundery weather in preventing decomposition during prolonged washing, and should be used according to maker's directions.

N.B.—The equivalents of English and French measures above given are approximate.

DEVELOPING VALUE OF THE ALKALIES.

The late W. B. Bolton's Table.

Caustic Soda.	Caustic Potash.	Ammonia NH_3.	Carbonate of Soda (anhydrous).	Carbonate of Soda (cryst.).	Carbonate of Potash (anhydrous).	Carbonate of Potash (cryst.).	Sesquicarbonate of Ammonia.
1	1·400	0·425	2·650	7·150	3·450	4·350	7·250
0·714	1·	0·304	1·893	5·170	2 464	3·107	5·178
2·353	3·294	1·	6·235	16·823	8·117	10·235	17 057
0·377	0·528	0 160	1·	2·698	1·301	1·641	2·736
0·140	0·196	0·059	0·370	1·	0·482	0·608	1·014
0·290	0·405	0·123	0·768	2 072	1·	1 261	2·101
0·230	0·322	0·098	0 609	1·644	0·793	1·	1·666
0·138	0·193	0·059	0·365	0·986	0·476	0·600	1·

CHEMICAL EQUIVALENCE OF THE ALKALIES.

Mr. G. E. Brown's Table.

Caustic Soda.	Caustic Potash.	Ammonia (·880 solution).	Carbonate of Soda (anhydrous).	Carbnate of Soda (cryst.).	Carbonate of Potash (anhydrous).	Carbonate of Potash (cryst.).	Sesquicarbonate of Ammonia.
80	112	97·14	106	286	138	174	127
1	1·400	·867	1·325	3·575	1·725	2·174	1·587
·714	*1*	1·211	·946	2·553	1·232	1·554	1·134
·834	1·153	*1*	1·091	2·944	1·421	1·791	1·307
·755	1·033	·916	*1*	2·698	1·302	1·641	1·198
·280	·392	·340	·371	*1*	·483	·608	·444
580	·812	·704	·768	2·072	*1*	1·260	·920
·460	·644	·558	·609	1·644	·793	*1*	·730
·630	·882	·765	·835	2·252	1·087	1·370	*1*

TABLES FOR THE SIMPLIFICATION OF EMULSION CALCULATIONS.

WITH a view of simplifying the calculations involved in emulsion-making, the late Mr. William Ackland a few years ago worked out some useful tables, which will enable even those most ignorant of chemical philosophy to calculate with ease and rapidity the proper quantities of silver or haloid salts in any formula. Even those who are able to perform the calculations in the recognised style will find their labours materially lightened by means of these tables, which should be kept in a convenient place for reference in every laboratory.

No. I.

	Equivalent weights.	Weight of $AgNO_3$ required to convert one grain of soluble haloid.	Weight of soluble haloid required to convert one grain $AgNO_3$.	Weight of *silver* haloid produced by one grain of *soluble* haloid.	Weight of *soluble* haloid required to produce one grain of *silver* haloid.	Weight of silver haloid produced from one grain $AgNO_3$.
Ammonium bromide	98	1·734	·576	1·918	·521	1·106
Potassium ,, ...	119·1	1·427	·700	1·578	·633	
Sodium ,, ...	103	1·650	·606	1·825	·548	
Cadmium ,, com.	172	·988	1·012	1·093	·915	
,, ,, anh.	136	1·25	·800	1·382	·723	
Zinc ,, ...	112·1	1·509	·663	1·670	·600	
Ammonium chloride	53·5	3·177	·315	2·682	·373	·844
Sodium ,, ...	58·5	2·906	·344	2·453	·408	
Ammonium iodide	145	1·172	·853	1·620	·617	1·382
Potassium ,, ...	166·1	1·023	·977	1·415	·707	
Sodium ,, ...	150	1·133	·882	1·566	·638	
Cadmium ,, ...	183	·929	1·076	1·284	·778	

The principal bromides, chlorides, and iodides which are likely to be used in emulsions of either gelatine or collodion have been included in these tables. Table No. I. presents to the reader, without any mystification which may be involved in equivalents, the actual weights of haloid or silver, as the case may be, required to convert or combine with one grain of the other.

In order to test the utility of this table, let us suppose that it is desired to make (say) ten ounces of emulsion by a new formula, which, for the sake of showing the working of the table, we will write down as follows :—

Bromide of potassium	150 grains.
Iodide of potassium	10 ,,
Chloride of ammonium	10 ,,
Gelatine	200 ,,

Now we want to know how much silver nitrate should be employed in sensitising this mixture. For this purpose we use the first column, in which we find against each haloid the exact quantity of silver nitrate required to fully decompose one grain. Taking, then, the figures we find in column No. 1 against the three salts in the above formula, and multiplying them by the number of grains of each used, we have the following sum :—

Potassium bromide .... 150 × 1·427 = 214 } Weight
,, iodide .... 10 × 1·023 = 10·23 } silver nitrate
Chloride of ammonium ... 10 × 3·177 = 31·77 } required,

or the total quantity of silver nitrate required for full conversion, 256·00 grains.

No. II.

	Ammonium Bromide.	Potassium Bromide.	Sodium Bromide.	Cadmium Bromide. (Coml.)	Cadmium Bromide. (Anhyd.)	Zinc Bromide.	Ammonium Chloride.	Sodium Chloride.	Ammonium Iodide.	Potassium Iodide.	Sodium Iodide.	Cadmium Iodide.
Ammonium bromide…………	**1**	·823	·951	·57	·72	·87	1·832	1·675	·676	·59	·653	·535
Potassium ,, …………	1·215	**1**	1·156	·692	·876	1·058	2·226	2·036	·821	·717	·794	651
Sodium ,, …………	1·051	·865	**1**	·599	·757	·915	1.925	1·761	·71	·62	·686	·563
Cadmium ,, com.	1·755	1·444	1·67	**1**	1·265	1·527	3·215	2·94	1·186	1·035	1·146	·94
,, ,, anh.	1·387	1·141	1·32	·79	**1**	1·207	2·542	2·324	·938	·819	·906	·743
Zinc ,, …………	1·149	·945	1·093	·655	·828	**1**	2·104	1·925	·776	·678	·75	·615
Ammonium chloride…………	·546	·449	·519	·311	·393	·475	**1**	·914	·369	·322	·356	·292
Sodium ,, …………	·597	·491	·568	·34	·43	·519	1·093	**1**	·403	·352	·39	·319
Ammonium iodide……………	1·479	1·217	1·408	·843	1·066	1·287	2·712	2·478	**1**	·873	·966	·792
Potassium ,, ……………	1·695	1·394	1·612	·965	1·221	1·475	3·104	2·839	1·145	**1**	1·107	·907
Sodium ,, ……………	1·53	1·259	1·456	·872	1·103	1·332	2·803	2·564	1·034	·903	**1**	·819
Cadmium ,, ……………	1·867	1·536	1·776	1·064	1·345	1·625	3·42	3·128	1·262	1·102	1·22	**1**

TABLE No. II. gives in separate columns the relative converting values of each of the soluble haloid salts in ordinary use, showing how much of any salt must be used to replace one grain of any other. In each column will be found a unit (printed in larger type) which represents one grain of the salt named at the head of the column; the other figures in the same column show the exact quantities of the other salts which must be used in lieu of a single grain of that particular haloid. Thus, taking the first column, which is headed 'Ammonium Bromide,' we find against ammonium bromide in the margin the figure 1, representing one grain of that salt. If we wish to know the relative converting power of potassium bromide we take the number in the same column which stands against the latter salt in the margin, viz., 1·215; that is to say, 1·215 grain of potassium bromide will be required to do the same work as one of NH_4Br.

SOLUBILITY OF THE SILVER HALOIDS.

By E. VALENTA.

In the *Royal Photographic Society's Journal* the following table, the result of a series of experiments, was given.

Solvent.	Concentration.	100 g. of solution can dissolve in grammes.			Remarks.
		Ag Cl.	Ag Br.	Ag I.	
Sodium hyposulphite	1 : 100	0·40	0·35	0·03	The estimations were made at 20° C.
”	5 : 100	2·00	1·90	0·15	
”	10 : 100	4·10	3·50	0·30	
”	15 : 100	5·50	4·20	0·40	
”	20 : 100	6·10	5·80	0·60	
Ammonium hyposulphite............	1 : 100	0·57	—	—	For bromide and iodide of silver similar results were obtained as with sodium hyposulphite.
”	5 : 100	1·32	—	—	
”	10 : 100	3·92	—	—	
Sodium sulphite........................	10 : 100	0·44	0·04	0·01	
”	20 : 100	0·95	0·08	0·02	
Ammonium sulphite	10 : 100		traces		
Ammonium carbonate	10 : 100	0·05	—	—	
Ammonia................................	3°/o	1·40	—	—	
”	15°/o	7·58	—	—	
Magnesium chloride	50 : 100	0·50	—	—	
Potassium cyanide......................	5 : 100	2·75	6·55	8·23	25° C.
Ammonium sulphocyanide	5 : 100	0·08	0·21	0·02	23° C.
”	10 : 100	0·54	2·04	0·08	
”	15 : 100	2·88	5·30	0·13	
Potassium sulphocyanide............	10 : 100	0·11	0·73	—	25° C.
Calcium sulphocyanide...............	10 : 100	0·15	0·53	0·03	
Barium sulphocyanide................	10 : 100	0·20	0·35	0·02	
Aluminium sulphocyanide	10 : 100	2·02	4·50	0·02	
Thiocarbamide	10 : 100	0·83	1·87	0·79	25° C.
Thiosinamin	1 : 100	0·40	0·08	0·008	
....	5 : 100	1·90	0·35	0·05	
”	10 : 100	3·90	0·72	0·09	

A TABLE OF ATOMIC WEIGHTS OF SEVENTY-FOUR ELEMENTS.

By T. W. Richards.

From the 'American Chemical Journal.'

Name.	Symbol.	Atomic Weight.
Aluminium	Al	27·1
Antimony	Sb	120·0
Argon	A	39·9 ?
Arsenic	As	75·0
Barium	Ba	137·43
Beryllium	Be = Gl	9·1
Bismuth	Bi	208·0
Boron	B	10·95
Bromine	Br	79·955
Cadmium	Cd	112·3
Cæsium	Cs	132·9
Calcium	Ca	40·0
Carbon	C	12·001
Cerium	Ce	140·0
Chlorine	Cl	35·455
Chromium	Cr	52·14
Cobalt	Co	59·00
Columbium	Cb = Nb	94·0
Copper	Cu	63·60
'Didymium'	Nd + Pr	142 ±
Erbium	Er	166·0
Fluorine	F	19·05
Gadolinium	Gd	156·0 ?
Gallium	Ga	70·0
Germanium	Ge	72·5
Glucinum	Gl = Be	9·1
Gold	Au	197·3
Helium	He	4·0 ?
Hydrogen	H	1·0075
Indium	In	114·0
Iodine	I	126·85
Iridium	Ir	193·0
Iron	Fe	56·0
Lanthanum	La	138·5
Lead	Pb	206·92
Lithium	Li	7·03
Magnesium	Mg	24·36
Manganese	Mn	55·02
Mercury	Hg	200·0

A TABLE OF ATOMIC WEIGHTS—Continued.

Name.	Symbol.	Atomic Weight.
Molybdenum	Mo	96·0
Neodymium	Nd	143·6
Nickel	Ni	58·70
Niobium	Nb = Cb	94·0
Nitrogen	N	14·045
Osmium	Os	190·8
Oxygen (Standard)	O	16·000
Palladium	Pd	106·5
Phosphorus	P	31·0
Platinum	Pt	195·2
Potassium	K	39·140
Praseodymium	Pr	140·5
Rhodium	Rh	103·0
Rubidium	Rb	85·44
Ruthenium	Ru	101·7
Samarium	Sm	150·0
Scandium	Sc	44·0
Selenium	Se	79·0
Silicon	Si	28·4
Silver	Ag	107·93
Sodium	Na	23·050
Strontium	Sr	87·68
Sulphur	S	32·065
Tantalum	Ta	183·0
Tellurium	Te	127·5
Terbium	Tb	160·0
Thallium	Tl	204·15
Thorium	Th	233·0
Thulium	Tu	170·0 ?
Tin	Sn	119·0
Titanium	Ti	48·17
Tungsten	W	184·4
Uranium	U	240·0
Vanadium	V	51·4
Ytterbium	Yb	173·0
Yttrium	Yt	89·0
Zinc	Zn	65·40
Zirconium	Zr	90·5

TABLE OF SYMBOLS AND EQUIVALENT WEIGHTS OF THE MORE IMPORTANT COMPOUNDS USED IN PHOTOGRAPHY.

NAME.	SYMBOL.	
Acetone	$CH_3\ CO\ CH_3$	58
Acid, Acetic	$CH_3\ COOH$	60
,, Boracic	$H_3\ BO_3$	62
,, Citric	$C_6\ H_8\ O_7 + Aq$	210
,, Formic	$H\ COOH$	46
,, Gallic	$C_6\ H_2\ (OH)_3\ COOH$	188
,, Hydriodic	HI	128
,, Hydrobromic	$H\ Br$	81
,, Hydrochloric	$H\ Cl$	36·5
,, Hydrocyanic	$H\ CN$	27
,, Hydrosulphuric	$H_2\ S$	34
,, Nitric	$H\ NO_3$	63
,, Oxalic	$(COOH)_2 + 2\ Aq$	126
,, Pyrogallic	$C_6\ H_3\ (OH)_3$	126
,, Sulphuric	$H_2\ SO_4$	98
,, Sulphurous	$H_2\ SO_3$	82
,, Tannic	$C_{14}\ H_{10}\ O_9$	322
,, Tartaric	$C_2\ H_2\ OH_2\ (COOH)_2$	133
Alcohol (Methyl)	$CH_3\ OH$	32
,, (Ethyl)	$C_2\ H_5\ OH$	46
Alum (Chrome)	$K\ Cr\ (SO_4)_2\ 12\ Aq$	499·3
,, Potash	$K\ Al\ (SO_4)_2 + 12\ Aq$	474·5
Amidol	$C_6\ H_3\ OH\ (NH_2)_2\ (H\ Cl)_2$	196
Ammonium, Bichromate	$(NH_4)_2\ Cr_2\ O_7$	53
,, Bromide	$NH_4\ Br$	298
,, Chloride	$NH_4\ Cl$	53·5
,, Iodide	$NH_4\ I$	145
,, Nitrate	$NH_4\ NO_3$	80
,, Oxalate	$(NH_4)_2\ C_2\ O_4$	124
,, Sulphide	$NH_4,\ HS$	51
,, Sulphocyanide	$NH_4,\ CNS$	76
Barium, Bromide	$Ba\ Br_2 + 2\ Aq$	333
,, Chloride	$Ba,\ Cl_2 + 2\ Aq$	244
,, Iodide	$Ba\ I_2 + 2\ Aq$	427
,, Nitrate	$Ba,\ (NO_3)_2$	261
Benzole	$C_6\ H_6$	78
Cadmium, Bromide	$Cd\ Br_2 + 4\ Aq$	344
,, Chloride	$Cd\ Cl_2 + 2\ Aq$	219
,, Iodide	$Cd\ I_2$	366
Calcium, Bromide (Cryst.)	$Ca\ Br_2 + 4\ Aq$	272
,, Chloride (Cryst.)	$Ca\ Cl_2 + 6\ Aq$	219
,, Iodide	$Ca\ I_2$	294
Copper, Bromide	$Cu\ Br_2$	223 5
,, Chloride ,,	$Cu\ Cl_2 + 2\ Aq$	170·5
,, Sulphate ,,	$Cu\ SO_4 + 5\ Aq$	249·5

TABLES OF SYMBOLS, &c.—CONTINUED.

NAME.	SYMBOL.	
Eikonogen	$C_{10} H_5 OH (NH_2)_2 (H Cl)_2$	247
Formaline	H CHO	30
Glycerine	$C_3 H_5 (OH)_3$	92
Gold, Chloride	$Au Cl_3 + 2 Aq$	339·2
Hydroquinone	$C_6 H_4 (OH)_2$	110
Iridium, Perchloride	$Ir Cl_4$	335
Iron, Chloride (ferrous)	$Fe Cl_2 + 4 Aq$	199
,, ,, (ferric)	$Fe_2 Cl_6$	325
,, Citrate	$Fe_2 (C_6 H_5 O_7)_2$	598
,, Iodide	$Fe I_2 + 4 Aq$	382
,, Oxalate (ferrous)	$Fe C_2 O_4$	144
,, ,, (ferric)	$Fe_2 (C_2 O_4)_3$	376
,, Sulphate (ferrous)	$Fe SO_4 + 7 Aq$	278
,, ,, (ferric)	$Fe_2 (SO_4)_3$	400
,, Ammonia-sulphate	$Fe SO_4 (NH_4)_2 SO_4 + 6 Aq$	392
Lead, Acetate	$Pb (C_2 H_3 O_2)_2 + 3 Aq$	379
,, Nitrate	$Pb (NO_3)_2$	331
Lithium, Bromide	Li Br	87
,, Chloride	Li Cl	42·5
,, Iodide	Li I	134
Magnesium, Bromide	$Mg Br_2$	184
,, Chloride	$Mg Cl_2 + 6 Aq$	203
,, Iodide	$Mg I_2$	278
Mercury, Chloride (Mercuric)	$Hg Cl_2$	271
Metol	$C_6 H_4 OH CH_3 NH (H_2 SO_4)_2$	349
Para-amidophenol	$C_6 H_4 OH NH_2 HCl$	145
Platinum, Chloride (Platinic)	$Pt Cl_4 + 8 Aq$	483·4
,, ,, (Platinous)	$Pt Cl_2$	268·4
Potassium, Acetate	$K_2 C_2 H_3 O_2$	137
,, Bichromate	$K_2 Cr_2 O_7$	295
,, Bromide	K Br	119·1
,, Carbonate	$K_2 CO_3 + 2 Aq$	174
,, Chlorate	$K Cl O_3$	122·5
,, Chloride	K Cl	74·5
,, Citrate	$K_3 C_6 H_5 O_7 + Aq$	324·3
,, Cyanide	K C N	65
,, Ferridcyanide	$K_6 Fe_2 Cy_{12}$	658
,, Ferrocyanide	$K_4 Fe Cy_6 + 3 Aq$	422
,, Hydrate	K OH	56·1
,, Iodide	K I	166
,, Nitrate	$K NO_3$	101
,, Oxalate	$K C_2 O_4 + Aq$	235
,, Permanganate	$K_2 Mn_2 O_8$	316
,, Platino-chloride	$(K_2 Pt Cl_4)$	342·1
,, Sulphocyanide	K Cy S	97
Silver, Acetate	$Ag C_2 H_3 O_2$	167
,, Bromide	Ag Br	188

TABLES OF SYMBOLS, &c.—Continued.

Name.	Symbol.	
Silver, Carbonate	$Ag_2 CO_3$	276
,, Chloride	$Ag Cl$	143·5
,, Citrate	$Ag_3 C_6 H_5 O_7$	513
,, Fluoride	$Ag Fl$	127
,, Iodide	$Ag I$	235
,, Nitrate	$Ag NO_3$	170
,, Oxalate	$Ag_2 C_2 O_4$	304
,, Oxide	$Ag_2 O$	232
,, Sulphide	$Ag_2 S$	248
Sodium, Acetate	$Na C_2 H_3 O_2 + 3 Aq$	136
,, Biborate (Borax)	$Na_2 B_4 O_7 + 10 Aq$	382
,, Bichromate	$Na_2 Cr_2 O_7 + 2 Aq$	299
,, Bromide	$Na Br + 4 Aq$	175
,, Carbonate (Cryst.)	$Na_2 CO_3 + 10 Aq$	286
,, Chloride	$Na Cl$	58·5
,, Hydrate	$Na H O$	40
,, Hyposulphite (Cryst.)	$Na_2 S_2 O_3 + 5 Aq$	248
,, Iodide	$Na I + 4 Aq$	222
,, Sulphite	$Na_2 SO_3 + 7 Aq$	252
Strontium, Bromide	$Sr Br_2$	247·5
,, Chloride	$Sr Cl_2$	158·5
,, Iodide	$Sr I_2$	341·5
Tin, Chloride (Stannous)	$Sn Cl_2 + 2 Aq$	225
,, ,, Stannic	$Sn Cl_4$	260
Uranium, Bromide	$U Br_2 + 4 Aq$	352
,, Nitrate	$U_2 O_3 (NO_3)_2 + 6 Aq$	504
Zinc, Bromide	$Zn Br_2$	225·2
,, Chloride	$Zn Cl_2$	136·2
,, Iodide	$Zn I_2$	319·2

TABLE OF THE SOLUBILITIES OF THE PRINCIPAL SUBSTANCES USED IN PHOTOGRAPHY.

	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol.
	Cold.	Boiling.		
Acid, Boracic (Anhydrous)	47·01	...	2·13	soluble
,, ,, (Cryst.)	25·66	3·0	3·9	sol. in 6 parts @ 60°
,, Citric	0·75	0·5	133·0	sol. in 1·15 pt. s. g. 820
,, Gallic	100·0	3·0	1·0	soluble in 4 parts
,, Oxalic	15·5	1·0	6·47	insoluble
,, Pyrogallic	2·25	...	...	sol. in alc. and ether
,, Salicylic	87·2	vry sol	0·35	easily soluble
,, Succinic	5·0	2·2	20·0	soluble in 3 parts
,, Tannic	0·8	·5	...	sol. in alc. and ether
,, Tartaric	·66	·5	150·0	soluble
Alum (Potash)	10·5	vry sol	9·52	insoluble
,, (Ammonia)	7·32	,,	13·66	,,
Amidol	4	2	...	
Ammonium, Bichromate	sol.	sol.	...	insoluble
,, Bromide	1·4	0·78	41·1	sol. in 32·3 parts
,, Carbonate	3·3	·833	33·0	insoluble
,, Chloride	2·7	1·00	37·02	sparingly soluble
,, Citrate	deliqu	escent	vy. sol.	less sol. in alcohol
,, Fluoride	vry sol	vry sol	...	slightly soluble
,, Iodide	very	solubl	e ...	soluble
,, Nitrate	2·0	1·0	50·0	freely soluble
,, Nitrite	del.	dec.		
,, Oxalate	4·0	2·0	...	soluble
,, Salicylate	very	solubl	e	
,, Succinate	,,	,,		
,, Sulphocyanide	·4	vry sol	easily	sol. in water and alc.
Barium, Bromide	·96	·5	104·2	easily soluble
,, Chloride { Crystallised	2·18	1·5	46·0	very slightly soluble
Anhydrous.	2·862	...	34·1	
,, Iodide	0·48	0·35	208·3	very soluble
,, Nitrate	12·2	2·84	8·18	
,, Sulphate	insol.			
Bromine	33	dec.	vy. sol.	
Cadmium, Bromide	easily	solubl	e	soluble in 3·4
,, Chloride	0·71	0·67	...	,,
,, Iodide	1·08	0·75	92·6	1 in ·98 abs. alc.
Calcium, Bromide (Cryst.)	0·97	...	102·56	easily soluble
,, Chloride	0·25	any qy	400·0	
,, Iodide	deliqu	escent		
Cobalt, Chloride	very	solubl	e	sol. in alc. and ether
Copper, Acetate	14	5	...	14
,, Bromide (Cupric)	1	·75	...	,, ,,
,, Chloride ,,	·75	·75	vy. sol.	,, ,,
,, Nitrate	solubl	e	...	very soluble
,, Sulphate	2·5	·5	40·0	insoluble

TABLE OF THE SOLUBILITIES, &c.—Continued.

	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol.
	Cold.	Boiling.		
Eikonogen	40·0	vry sol	...	soluble
Gold, Perchloride	1	0·75	vy. sol.	soluble in ether
Iron, Chloride Anhyd.	2·0	...		sol. in 1 part alcohol
(Ferrous) Hydrated	0·68	...	50·0	easily soluble
,, Chloride (Ferric)	0·75	·5	147·0	very soluble
,, Oxalate ,,	insolu	ble, ex	cept in	excess of oxalic acid
,, Sulphate ,,	solubl	e	...	soluble
,, ,, (Ferrous)	1·3	·30	77·0	insoluble
Lead, Acetate	3·7	3·45	27·0	soluble in 12·5 parts
,, Nitrate	7·7	...	13·0	
Lithium, Bromide	0·66	0·5	149·8	soluble
,, Chloride	1·315	1	76·0	
,, Iodide	0·61	0 75	164·0	
Magnesium, Bromide	deliqu	escent	vy. sol.	very soluble
,, Chloride	1·857	...	53·8	
,, Iodide	1	0·75	vy. sol.	soluble 1 in 5
,, Sulphate	1·47	0·66	68·04	slightly soluble
Mercury, Chloride (Mercuric)	16·0	3·0	6·25	soluble in 2·35 parts
Metol	18	10		
Platinum, Bichloride	1	0 5	...	easily sol. in alc. & ether
Potassium, Bichromate	10·0	7	10·0	
,, Bromide	1·55	1	64·5	
,, Carbonate	0·9	0·5	111·0	
,, Chloride	3·03	2·0	33·0	slightly soluble
,, Chloroplatinite	5·9	3		
,, Citrate	0·6	0·3		
,, Cyanide	1	0 5	vy. sol.	insol. in pure alcohol
,, Ferrocyanide	3·0	1·0	33·3	insoluble
,, Ferridcyanide	2·54	1·22	39·37	very sparingly soluble
,, Hydrate	0·5	0·25	200·0	very soluble
,, Iodide	0·7	0·27	143·0	sol. in 40 pts. abs. alc.
,, Nitrate	3·5	0·4	28·57	insoluble
,, Nitrite	deliqu	& solu	ble	
,, Oxalate (neutral)	3·0	2	33·3	slightly soluble
,, ,, (bin.)	40·0	...	2·5	insoluble
,, ,, (quad.)	20·17	...	4·95	insoluble
,, Permanganate	16·0	10	6·25	insoluble
,, Sulphocyanide	2	1	–	insoluble
Silver, Acetate	very	slightl	y sol.	
,, Citrate	solubl	e in wa	rm wate	r
,, Fluoride	deliqu	escent		
,, Nitrate	1·0	0·5	100·0	sol. in 4 pts. boiling alc.
,, Nitrite	300·0	dissol. easily	0·33	insoluble

TABLE OF THE SOLUBILITIES, &c.—CONTINUED.

	One part is soluble in — parts of water.		100 parts of water dissolve at ordinary temperature.	Solubility in Alcohol.
	Cold.	Boiling.		
Silver, Oxalate	spar'ly sol.	solubl	e ...	insoluble
,, Sulphate	200·0	88·0	0·5	insoluble
Sodium, Acetate (Cryst.) ...	2·86	·66	35·0	
,, Biborate (Borax)...	12·44	2·0	8·033	insoluble
,, Bromide	1·13	1·0	88·5	
,, Carbonate (Cryst.)	2·0	1·0	50·0	insoluble
,, ,, (Anhyd.)	3·85	2·07	25·93	insoluble
,, Chloride	2·77	2·77	36·0	sparingly soluble
,, Citrate	1·0	0·5	100·0	sparingly soluble
,, Hydrate	1·65	0·5	60·63	easily soluble
,, Hyposulphite ... (Thiosulphate)	1 5	0·5	vy. sol.	insoluble
,, Iodide	0·55	0·3	180·0	sparingly soluble
,, Nitrate	1·136	1·0	88·03	sol. in 37 parts alc.
,, Nitrite	deliqu	escent	vy. sol.	very soluble
,, Phosphate	4·0	2·0	25·0	
,, Succinate	very s	oluble		
,, Sulphate	2·08	0·41	48·0	soluble
,, Sulphite	4·0	2·0	25·0	slightly soluble
,, Bisulphite	very s	oluble	...	insoluble
,, Sulphocyanide ...				
,, Tartrate	1·75	...	56·37	insoluble
,, Tungstate	4·0	2·0	25·0	
Strontium, Bromide	1·01	...	99·0	sparingly soluble
,, Chloride	1·88	...	53·0	feebly soluble
,, Iodide	0·56	0·27	178·5	
Uranium, Bromide ...... (Hydrated)...	1	0·5	...	soluble
,, Nitrate	0·5	0·25	200·0	sol. in alc. and ether
,, Oxalate	nearly insol.	30·0	...	insoluble
Zinc, Bromide	deliqu	escent	vy. sol.	very soluble
,, Chloride	0·333	...	300·0	very soluble
,, Iodide	vy. de	liques.	& sol.	very soluble

Percentage of Real Ammonia in Solutions of different Densities at 14° Centigrade.—CARIUS.

Specific Gravity.	Percentage Ammonia.	Specific Gravity.	Percentage Ammonia.	Specific Gravity.	Percentage Ammonia.	Specific Gravity.	Percentag Ammonia
0·8844	36·0	0·9052	27·0	0·9314	18·0	0·9631	9·0
0·8864	35·0	0·9078	26·0	0·9347	17·0	0·9670	8·0
0·8885	34·0	0·9106	25·0	0·9380	16·0	0·9709	7·0
0·8907	33·0	0·9133	24·0	0·9414	15·0	0·9749	6·0
0·8929	32·0	0·9162	23·0	0·9449	14·0	0·9790	5·0
0·8953	31·0	0·9191	22·0	0·9484	13·0	0·9831	4·0
0·8976	30·0	0·9221	21·0	0·9520	12·0	0·9873	3·0
0·9001	29·0	0·9251	20·0	0·9556	11·0	0·9915	2·0
0·9026	28·0	0·9283	19·0	0·9593	10·0	0·9959	1·0

THERMOMETRIC TABLES,

SHOWING THE ASSIMILATION OF THE THERMOMETERS IN USE THROUGHOUT THE WORLD.

Celsius.	Réaumur.	Fahrenheit.	Celsius.	Réaumur.	Fahrenheit.
100	80·0	212·0	49	39·2	120·2
99	79·2	210·0	48	38·4	118·4
98	78·4	208·4	47	37·6	116·6
97	77·6	206·6	46	36·8	114·8
96	76·8	204·8	45	36·0	113·0
95	76·0	203·0	44	35·2	111·2
94	75·2	201·2	43	34·8	109·4
93	74·4	199·4	42	33·6	107·6
92	73·6	197·6	41	32·8	105·8
91	72·8	195·8	40	32·0	104·0
90	72·0	194·0	39	31·2	102·2
89	71·2	192·2	38	30·4	100·4
88	70·4	190·4	37	29·6	98·6
87	69·6	188·6	36	28·8	96·8
86	68·8	186·8	35	28·0	95·0
85	68·0	185·0	34	27·2	93·2
84	67·2	183·2	33	26·4	91·4
83	66·4	181·4	32	25·6	89·6
82	65·6	179·6	31	24·8	87·8
81	64·8	177·8	30	24·0	86·0
80	64·0	176·0	29	23·2	84·2
79	63·2	174·2	28	22·4	82·4
78	62·4	172·4	27	21·6	80·6
77	61·6	170·6	26	20·8	78·8
76	60·8	168·8	25	20·0	77·0
75	60·0	167·0	24	19·2	75·2
74	59·2	165·2	23	18·4	73·4
73	58·4	163·4	22	17·6	71·6
72	57·6	161·6	21	16·8	69·8
71	56·8	159·8	20	16·0	68·0
70	56·0	158·0	19	15·2	66·2
69	55·2	156·2	18	14·4	64·4
68	54·4	154·4	17	13·6	62·6
67	53·6	152·6	16	12·8	60·8
66	52·8	150·8	15	12·0	59·0
65	52·0	149·0	14	11·2	57·2
64	51·2	147·2	13	10·4	55·4
63	50·4	145·4	12	9·6	53·6
62	49·6	143·6	11	8·8	51·8
61	48·8	141·8	10	8·0	50·0
60	48·0	140·0	9	7·2	48·2
59	47·2	138·2	8	6·4	46·4
58	46·4	136·4	7	5·6	44·6
57	45·6	134·6	6	4·8	42·8
56	44·8	132·8	5	4·0	41·0
55	44·0	131·0	4	3·2	39·2
54	43·2	129·2	3	2·4	37·4
53	42·4	127·4	2	1·6	36·5
52	41·6	125·6	1	0·8	33·8
51	40·8	123·8	0	0·0	32·0
50	40·0	122·0			

THERMOMETRIC RULES.

The following rules for the rapid conversion of degrees in one system into another will be found useful.

To Convert Centigrade into Reaumur:
Degrees Reaumur × 4 ÷ 5.
Ex.—80° R × 4 ÷ 5 = 64° C.

To Convert Centigrade into Fahrenheit:
Degrees Centigrade (× 9 ÷ 5) + 32.
Ex.—80° C × 9 ÷ 5 = 144 + 32 = 176° F.

To Convert Reaumur into Centigrade:
Degrees Reaumur × 5 ÷ 4.
Ex.—60° R × 5 ÷ 4 = 75° C.

To Convert Fahrenheit into Centigrade:
(Degrees Fahr.—32) × 5 ÷ 9.
Ex.—100°.F − 32 = 78 × 5 ÷ 9 = 43·3° C.

To Convert Reaumur into Fahrenheit:
Degrees Reaumur (× 9 ÷ 4) + 32.
Ex.—16° R × 9 ÷ 4 = 36 + 32 = 68° F.

To Convert Fahrenheit into Reaumur:
(Degrees Fahrenheit—32) ÷ 9 × 4.
Ex.—95° F − 32 = 63 ÷ 9 × 4 = 28° R.

TABLE OF THE WAVE-LENGTHS OF THE PRINCIPAL FRAUENHOFER SPECTRUM LINES AND THE ELEMENTS THAT GIVE THEM.

Colour.	Wave-lengths in μμ	Element	Colour.	Wave-lengths in μμ	Element.
Infra red	Y 899·04		Ultra-violet	K 393·386	Ca
	898·65			L 382·056	Fe
	X^{IV} 880·61			M 372·778	Fe
	X^{III} 866·14			372·713	Fe
	X^{II} 854·18			N 358·132	Fe
	X^{I} 849·70			O 344·107	Fe
	Z 822·64			344·069	Fe
Red	A 759·397			P 336·130	Ca
	B 686·738	O (?)		Q 328·687	Fe
Orange	C 656·296	H		R 318·030	Fe
Yellow	D^1 589·608	Na		S 310·077	Fe
	D^2 589·013	Na		310·038	Fe
Green	E 527·043	Fe		310·004	Fe
	526·965	Fe		T 302·115	Fe
	b^1 518·373	Mg		302·070	Fe
Cyanine blue	F 486·143	H		U 294·800	Fe
Indigo	G 430·796	Fe		294·777	Fe
Violet	h 410·184	H			
	H 396·861	Ca			

RELATIVE EXPOSURES FOR VARYING PROPORTIONS OF IMAGE TO THE ORIGINAL.

[The following paper was read before the Royal Photographic Society by Mr. W. E. Debenham. Its usefulness would be diminished by abbreviation, hence we reproduce it in full.—Ed.]

When an enlarged photograph has to be made, either from a negative or print, it is commonly understood that the greater the degree of enlargement the longer will be the exposure required, but I have generally found only the vaguest ideas to exist as to the amount by which such exposure has to be prolonged. Sometimes, indeed, it is assumed that the exposure will be in direct inverse proportion to the area covered, so that a copy of twice the linear dimensions of the original—covering, as it does, the area of four times the size—would require an exposure of four times that sufficing for a copy of the same size. This calculation, however, omits to recognise an important factor, and leads to serious error, the actual exposure required in the case mentioned (assuming the same lens and stop to be used) being not four times, but two and a quarter times, that of a copy of same size; whilst, when we come to high degrees of enlargement, the error would amount to an indication of nearly four times the exposure actually required.

To find the relative exposure, add one to the number of times that the length of the original is contained in the length of the image, and square the sum. This will give the figure found in the third column of the annexed table.

As examples: suppose a copy is wanted having twice the linear dimensions of the original. Take the number 2, add 1 to it, and square the sum, $3^2=9$. Again, if a copy is to be of eight times the linear dimensions of the original, take the number 8, add 1, and square the sum, $9^2=81$. Copies respectively twice and eight times the size (linear) of the original will thus require relative exposures of 9 and 81—*i.e.*, the latter will require nine times the exposure of the former.

It is convenient to have a practical standard for unity. An image of the same size as the original is a familiar case, and serves as such standard. By dividing the figures in the third column by four, we get at the figures in the last column, which represent the exposure required for varying degrees of enlargement or reduction, compared with the exposure for a copy of the same size.

The table is carried up to enlargements of thirty diameters; that is about the amount required for enlarging a small *carte-de-visite* to life size.

The exposures required in reductions do not vary at all to the same extent that they do in enlargements. It has, therefore, not been thought necessary to fill in the steps between images of $\frac{1}{10}$ and $\frac{1}{20}$, and between $\frac{1}{20}$ and $\frac{1}{30}$ of the size of the original. Beyond $\frac{1}{30}$ there is scarcely any perceptible difference in the exposure until disturbance comes in from another cause, a considerable distance of illuminated atmosphere (haze or fog) intervening.

The figures in the second column will also serve as a table for distances from the lens to the plate and to the original, all that is necessary being to multiply by the principal focus of the lens in use. In the case of enlargements the figures less than 2 must be multiplied to get the distance from the original to the lens, and the figures greater than 2 or the distance from lens to image. For reductions, the figures less than 2, multiplied by the principal focus of the lens, yield the distance from lens to plate; and the figures higher than 2, similarly multiplied, give the distance of original from lens.

Proportion of image to original (linear).	Distance of image from lens * in terms of principal focus.	Proportionate exposures.	Exposures proportioned to that required for copying same size.
$\frac{1}{30}$	$1\frac{1}{30}$	1·07	·27
$\frac{1}{20}$	$1\frac{1}{20}$	1·10	·28
$\frac{1}{10}$	$1\frac{1}{10}$	1·21	·3
$\frac{1}{8}$	$1\frac{1}{8}$	1·27	·31
$\frac{1}{6}$	$1\frac{1}{6}$	1·36	·34
$\frac{1}{4}$	$1\frac{1}{4}$	1·56	·39
$\frac{1}{2}$	$1\frac{1}{2}$	2·25	·56
$\frac{3}{4}$	$1\frac{3}{4}$	3·06	·76
(Same 1	2	4	1
size) 2	3	9	2·25
3	4	16	4
4	5	25	6·25
5	6	36	9
6	7	49	12·25
7	8	64	16
8	9	81	20·25
9	10	100	25
10	11	121	30·25
11	12	144	36
12	13	169	42·25
13	14	196	49
14	15	225	56·25
15	16	256	64
16	17	289	72·25
17	18	324	81
18	19	361	90·25
19	20	400	100
20	21	441	110·25
21	22	484	121
22	23	529	132·25
23	24	576	144
24	25	625	156·25
25	26	676	169
26	27	729	182·25
27	28	784	196
28	29	841	210·25
29	30	900	225
30	31	961	240·25

---

* With a double lens it is usually sufficient to measure from the position of the diaphragm plate.

‘UNIFORM SYSTEM’ NUMBERS FOR STOPS FROM $\frac{f}{1}$ TO $\frac{f}{100}$.

In the following table Mr. S. A. Warburton has calculated the exposure necessary with every stop from $\frac{f}{1}$ to $\frac{f}{100}$ compared with the unit stop of the ‘uniform system’ of the Royal Photographic Society of Great Britain. The figures which are underlined show in the first column what $\frac{f}{a}$ must be in order to increase the exposure in geometrical ratio from $\frac{f}{4}$, the intermediate numbers showing the uniform system number for any other aperture.

	U. S. No.	*f*	U. S. No.	*f*	U. S. No.
1	1/16	15	14·06	58	210·25
1¼	·097	16	16	59	217·56
1·414	⅛	17	18·06	60	225·00
1½	·140	18	20·25	61	232·56
1¾	·191	19	22·56		240·25
2	¼	20	25·00	63	248·06
2¼	·316	21	27·56	64	256
2½	·390	22	30·25	65	264·06
2·828	½	22·62	32	66	272·25
2¾	·472	23	33·06	67	280·56
3	·562	24	36·00	68	289·00
3¼	·660	25	39·06	69	297·56
3½	·765	26	42·25	70	306·25
3¾	·878	27	45·56	71	315·06
4	1·00	28	49·00	72	324·00
4¼	1·12	29	52·56	73	333·06
4½	1·26	30	56·25	74	342·25
4¾	1·41	31	60·06	75	351·56
5	1·56	32	64	76	361·00
5¼	1·72	33	68·06	77	370·56
5½	1·89	34	72·25	78	380·25
5·656	2	35	76·56	79	390·06
5¾	2·06	36	81·00	80	400·00
6	2·25	37	85·56	81	410·06
6¼	2·44	38	90·25	82	420·25
6½	2·64	39	95·06	83	430·56
6¾	2·84	40	100·00	84	440·00
7	3·06	41	105·06	85	451·56
7¼	3·28	42	110·25	86	462·25
7½	3·51	43	115·56	87	473·06
7¾	3·75	44	121·00	88	484·00
8	4	45	126·56	89	495·06
8¼	4·25	45·25	128	90	506·25
8½	4·51	46	132·25	90·50	512
8¾	4·78	47	138·06	91	517·56
9	5·06	48	144·00	92	529·00
9¼	5·34	49	150·06	93	540·56
9½	5·64	50	156·25	94	552·25
9¾	5·94	51	162·56	95	564·06
10	6·25	52	169·00	96	576·00
11	7·56	53	175·56	97	588·06
11·31	8	54	182·25	98	600·25
12	9·00	55	189·06	99	612·56
13	10·56	56	196·00	100	625·00
14	12·25	57	203·06		

TABLE SHOWING THE HOURLY VARIATION IN THE SUN'S POSITION

CALCULATED BY

		A.M.						
Mean Time	4 A.M.	5	6	7	8	9	10	11
Jan. 1						41° E.	29° E.	16° E.
Feb. 1					59° E.	47	35	19
,, 20					63	50	36	20
Mar. 8				77° E.	65	52	37	21
,, 21				80	67	53	38	22
April 2			94° E.	82	69	55	40	21
,, 19		108° E.	97	85	72	58	41	21
May 8		111	100	89	76	61	44	22
,, 27	125° E.	114	103	91	79	65	47	26
June 22	127° E.	116	106	95	82	68	51	28
July 18		115	104	93	81	67	51	29
Aug. 5		114	101	91	78	62	47	27
,, 25			97	85	73	59	43	
Sept. 10			92	80	67	54	38	19
,, 23			88	77	64	50	35	17
Oct. 6				73	60	46	31	15
,, 22				69	57	44	29	12
Nov. 9					53	40	27	11
,, 22					52	39	25	11
Dec. 22						40	27	15

Calculated for latitude 52° N.

IN DEGREES FROM THE SOUTH, AT DIFFERENT SEASONS OF THE YEAR

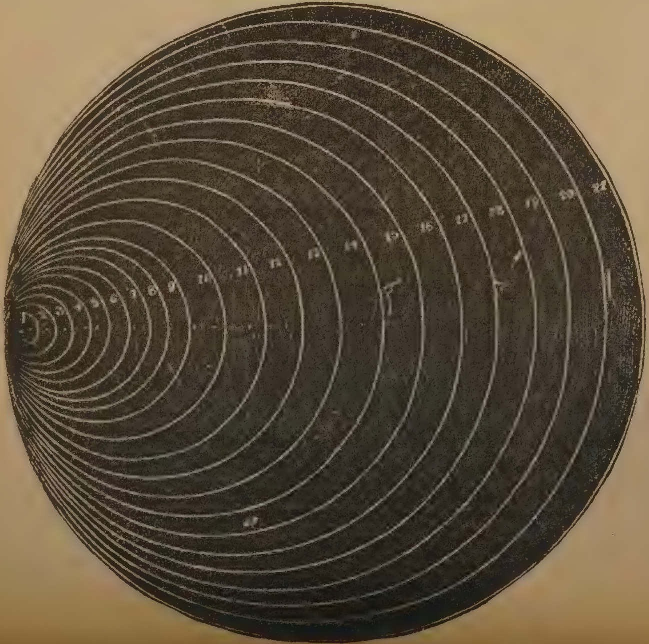
J. A. C. BRANFILL.

	P.M.							
Noon	1	2	3	4	5	6	7	8
1° E.	13° W.	27° W.	40° W.					
4	12	27	40	53° W.				
4	13	29	44	57				
4	15	31	46	61	73° W.			
3	17	34	49	64	77	89° W		
1	20	39	54	69	81	92		
1° W.	22	42	58	73	85	97	108° W.	
2	26	46	63	77	90	102	113	
1° W.	27	49	67	80	93	104	114	126° W.*
1° E.	27	49	67	81	94	105	115	127° W
2	23	46	64	79	91	102	113	125
2	22	44	61	75	88	100	111	
1	21	41	58	72	85	97	108*	
1° W.	21	39	55	69	82	94		
3	21	38	53	67	79			
4	21	37	52	65	77			
	20	36	50	63				
5	19	34	47	59				
4	19	33	45					
1° W.	15	28	41					

N.B.—Bearings marked * are taken when the sun is below the horizon.

THE ROYAL PHOTOGRAPHIC SOCIETY'S STANDARD DIAPHRAGMS.

The annexed diagram and table are intended to facilitate the calculation of the proper number with which to mark the diaphragms according to the Royal Photographic Society of Great Britain's Uniform System, which will be found described on another page. This number is called the 'U. S.' (or uniform system number). The numbered circles in the diagram represent the sizes of stops. The photographer, knowing the equivalent focus of his lens, looks along the line opposite the number which represents the circle nearest inside to his diaphragm, and when he gets to the column headed by that equivalent focus the number there found is the U. S. number to be marked on the diaphragm. For example: a lens of eight inches equivalent focus has a diaphragm in size about No. 5 on the diaphragm; running the eye along the line opposite No. 5, we find in the column under—'focus eight inches' the number 11, which is the U. S. number required.



No. of Circle.	4 focus	5 focus	6 focus	7 focus	8 focus	9 focus	10 focus	12 focus	14 focus
1	25	39	56						
2	11	17	25	34	44	56	68		
3	6¼	10	14	19	25	31	40	56	
4	4	6¼	9	12	16	20	25	36	48
5	2¾	4¼	6¼	8½	11	14	17	25	34
6	2	3⅕	4½	6¼	8	10	13	18	25
7	1½	2½	3½	4¾	6	8	10	14	19
8	1¼	2	2¾	3¾	5	6¼	8	11	15
9	1	1½	2¼	3	4	5	6¼	9	12¼
10		1	1½	2⅛	2¾	3½	4⅓	6	8½
11			1¼	1½	2	2½	3⅕	5	6
12			⅞	1⅕	1½	2	2½	3½	4¾
13				1	1¼	1⅚	1⅔	2¾	4
14					1	1¼	1½	2¼	3
15						1	1⅓	1⅞	2½
16							1	1½	2
17								1⅓	7⅔
18								1⅙	1½
19								1	1⅓
20									1⅕
21									1

STANDARDS OF THE ROYAL PHOTOGRAPHIC SOCIETY.

THE series of standards adopted by the Society in 1881, and modified in 1891, have been again carefully reconsidered by a committee of experts appointed by the Council. Their recommendations, which are embodied below, have been adopted by the Council, by whose orders this schedule is now published.

LENS DIAPHRAGMS.

(1) That intensity ratio be defined as dependent upon the *effective aperture*, and not upon the diameter of the diaphragm, in relation to the focal length of the lens.

(2) That effective aperture be determined in the following manner: The lens shall be focussed for parallel rays; an opaque screen shall be placed in the principal focal plane, the plate being provided in its centre (in the axis of the lens) with a pin-hole; an illuminant shall be placed immediately behind the pin-hole, and the diameter of the beam of light emerging from the front surface of the lens shall be the measure of the effective aperture.

NOTE.—It will be found, except when the diaphragm is situated in front of the lens, that the diameter of the diaphragm itself is seldom identical with the effective aperture.

(3) That every diaphragm be marked with its true intensity ratio, as above defined, in the following order of sequence: *f*-1, *f*-1·4.., *f*-2, *f*-2·8.., *f*-4, *f*-5·6.., *f*-8, *f*-11·3.., *f*-16, *f*-22·6.., *f*-32, *f*-45·2.., *f*-64, &c., each diaphragm requiring double the exposure required by the preceding diaphragm.

Should the greatest effective aperture of a lens not conform exactly to one of the intensities set forth above, this aperture should be marked in accordance with the definition of effective aperture, but all succeeding smaller apertures should be marked in uniformity with the intensities recommended in the above sequence.

LENS MOUNTS AND FITTINGS.

(1) That the equivalent focal length of a lens be engraved upon its mount.

(2) That the following series of screws for photographic lens flange fittings be adopted, it being understood that, in order to secure free interchangeability, every male screw should be made at least as small as these sizes, and every female screw at least as large:—

Diameter in Inches.	No. of Threads per Inch.	Core Diameter in Inches.
1*	24	·9466
1·25	24	1·1966
1·5	24	1·4466
1·75	24	1·6966
2	24	1·9466
2·25	24	2·1966
2·5	24	2·4466
3	24	2·9466
3·5	12	3·3933
4	12	3·8933
5	12	4·8933
And upwards, advancing by inches.	12	

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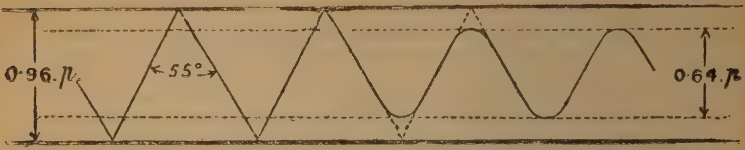
* For screws less than one inch in diameter, the Royal Microscopical Society' Standard screw should be adopted.

The Form of Thread is that known as Whitworth's Angular Thread, and is designed as follows:—



Two parallel lines, at a distance apart equal to 0·96 of the screw pitch, are intersected by lines inclined to each other at fifty-five degrees, is shown in the figure at A. One-sixth of the vertical height of the triangular spaces so obtained is rounded off both at the top and bottom, leaving the form of the screw thread as at B. The depth of this thread is 0·64 of the screw pitch. It should be understood that this is the theoretical form of the Whitworth thread, but that for the purpose of securing real interchangeability it is generally found necessary to use chasers or other threading tools which have additional prominence upon their points which come first into operation and are subject to most wear. For this purpose an addition may be made to the amount of one-tenth ($\frac{1}{10}$) of the theoretical depth of thread, or to any less amount that may be sufficient.

(3) That every flange and adapter have a mark upon its front to indicate the position of the diaphragm slot or index of any lens when screwed home. The mark on any adapter should coincide with the mark upon any flange into which it is screwed. This mark should be placed at the point at which the thread becomes complete at the shoulder of the flange or adapter.

CAMERA SCREWS.

That all screws fitted to cameras, either for attachment to the stand, for fixing rising fronts, or for other movable parts, be either $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, or $\frac{3}{8}$ of an inch in external diameter, and in pitch of thread and other details in accordance with the generally recognised Whitworth standards for these sizes.

TABLE FOR ENLARGEMENTS.

Focus of Lens, inches.	TIMES OF ENLARGEMENT AND REDUCTION.							
	1 inches.	2 inches.	3 inches.	4 inches.	5 inches.	6 inches.	7 inches.	8 inches.
2	4 4	6 3	8 2 2/3	10 2 1/2	12 2 2/5	14 2 1/3	16 2 2/7	18 2 1/4
2 1/2	5 5	7 1/2 3 3/4	10 3 1/3	12 1/2 3 1/8	15 3	17 1/2 2 11/12	20 2 6/7	22 1/2 2 13/16
3	6 6	9 4 1/2	12 4	15 3 3/4	18 3 3/5	21 3 1/2	24 3 3/7	27 3 3/8
3 1/2	7 7	10 1/2 5 1/4	14 4 2/3	17 1/2 4 3/8	21 4 1/5	24 1/2 4 1/12	28 4	31 1/2 3 15/16
4	8 8	12 6	16 5 1/3	20 5	24 4 4/5	28 4 2/3	32 4 4/7	36 4 1/2
4 1/2	9 9	13 1/2 6 3/4	18 6	22 1/2 5 5/8	27 5 2/5	31 1/2 5 1/4	36 5 1/7	40 1/2 5 1/16
5	10 10	15 7 1/2	20 6 2/3	25 6 1/4	30 6	35 5 5/6	40 5 5/7	45 5 5/8
5 1/2	11 11	16 1/2 8 1/4	22 7 1/3	27 1/2 6 7/8	33 6 3/5	38 1/2 6 5/12	44 6 2/7	49 1/2 6 3/16
6	12 12	18 9	24 8	30 7 1/2	36 7 1/5	42 7	48 6 6/7	54 6 3/4
7	14 14	21 10 1/2	28 9 1/3	35 8 3/4	42 8 2/5	49 8 1/6	56 8	63 7 7/8
8	16 16	24 12	32 10 2/3	40 10	48 9 3/5	56 9 1/3	64 9 1/7	72 9
9	18 18	27 13 1/2	36 12	45 11 1/4	54 10 4/5	63 10 1/2	72 10 2/7	81 10 1/8

THE object of this table is to enable any manipulator who is about to enlarge (or reduce) a copy any given number of times, to do so without troublesome calculation. It is assumed that the photographer knows exactly what the focus of his lens is, and that he is able to measure accurately from its optical centre. The use of the table will be seen from the following illustration:—A photographer has a *carte* to enlarge to four times its size, and the lens he intends employing is one of six inches equivalent focus. He must, therefore, look for 4 on the upper horizontal line, and for 6 in the first vertical column, and carry his eye to where these two join, which will be at 30—7½. The greater of these is the distance the sensitive plate must be from the centre of the lens; and the lesser, the distance of the picture to be copied. To *reduce* a picture any given number of times the same method must be followed, but in this case the greater number will represent the distance between the lens and the picture to be copied; the latter, that between the lens and the sensitive plate. This explanation will be sufficient for every case of enlargement or reduction.

If the focus of the lens be twelve inches, as this number is not in the column of focal lengths, look out for six in this column and multiply by 2 and so on with any other numbers.

TABLE OF VIEW-ANGLES.

By Clarence E. Woodman, Ph.D.

Divide the Base of the Plate by the Equivalent Focus of the Lens.

If the quotient is	The angle is	If the quotient is	The angle is	If the quotient is	The angle
	Degrees.		Degrees.		Degrees.
·282	16	·748	41	1·3	66
·3	17	·768	42	1·32	67
·317	18	·788	43	1·36	68
·335	19	·808	44	1·375	69
·353	20	·828	45	1·4	70
·37	21	·849	46	1·427	71
·389	22	·87	47	1·45	72
·407	23	·89	48	1·48	73
·425	24	·911	49	1·5	74
·443	25	·933	50	1·53	75
·462	26	·954	51	1·56	76
·48	27	·975	52	1·59	77
·5	28	1·	53	1·62	78
·517	29	1·02	54	1·649	79
·536	30	1·041	55	1·678	80
·555	31	1·063	56	1·7	81
·573	32	1·086	57	1·739	82
·592	33	1·108	58	1·769	83
·611	34	1·132	59	1·8	84
·631	35	1·155	60	1·833	85
·65	36	1·178	61	1·865	86
·67	37	1·2	62	1·898	87
·689	38	1·225	63	1·931	88
·708	39	1·25	64	1·965	89
·728	40	1·274	65	2·	90

Example.—Given a lens of 13 inches equivalent focus; required the angle included by it on plates respectively 3¼ × 4¼, 4¼ × 6½, 6½ × 8½, 8 × 10, 10 × 12, and 11 × 14.

1. Dividing 4·25 by 13, we have as quotient ·327—midway between the decimals ·317 and ·335 of our table; therefore the required angle is 18° 30′. Similarly—

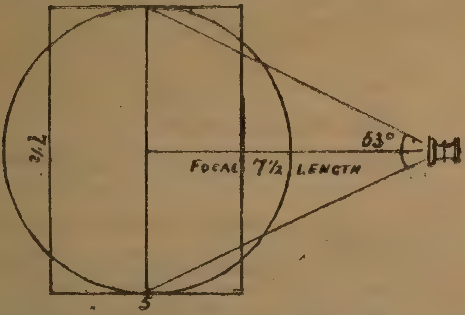
Degrees.
2. 6·5 ÷ 13 = ·5; corresponding to 28.
3. 8·5 ÷ 13 = ·654; ,, ,, 36.
4. 10 ÷ 13 = ·77; ,, ,, 42½.
5. 12 ÷ 13 = ·923 ,, ,, 49½.
6. 14 ÷ 13 = 1·08 ,, ,, 57.

VIEW-ANGLES.

THE late Mr. M. J. Michael wrote us as follows :—

'I take this opportunity of drawing your attention to the "Table of View-angles," in THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC. If used as there directed, it leads to results inaccurate and misleading; inaccurate, since the angle included on a plate should be measured along the diagonal and not along the base of the plate; and the information is misleading, since it leads to the supposition that a lens having the angle which is given by using the table, as there directed, will cover the plate mentioned. Hence all the examples given at the foot of the table specify lenses that, if used on the given plates, must leave at least two, and if the lens is placed centrally, all the four, corners uncovered. If the corners of a plate are to be covered, the angle embraced by the lens must be sufficient to cover the diagonal of the plate; in other words, the circle of illumination given by the lens must have a diameter equal to the diagonal of the plate, and not only equal to the length of the base of the plate.

'A simple figure makes this evident. If the focal length of the lens, *e.g.*, seven and a half inches on a 7½ × 5 plate, is equal to the base of the plate, then, using the table as is directed, the quotient obtained is 1 and the angle 53°. From the figure, which is to scale, it is evident that, arrange the plate as you will, at least two, and if placed centrally, all four corners must be uncovered, *i.e.*, outside the circle of illumination.



'The table itself is correct when used as is usually directed by dividing the diagonal of any given plate by the focal length of the lens (see Dr. Eder, *Recepte und Tabellen*, fourth edition, page 94). If, therefore, the directions for using it were altered by substituting "diagonal of the plate" for the words "base of the plate," the results obtained would be correct. It would save trouble if beneath the table were printed the length of the diagonals of the plates most commonly used :—

3¼ × 3¼	diagonal	4·6	inches.	6½ × 8½	diagonal	10·7	inches.
3¼ × 4¼	,,	5·3	,,	8 × 10	,,	12·4	,,
4 × 5	,,	6·4	,,	10 × 12	,,	15·6	,,
4¾ × 6½	,,	8·	,,	12 × 15	,,	19·4	,,
5 × 7½	,,	9·	,,				

EQUATIONS RELATING TO FOCI, &c.

The following simple optical formulæ and calculations, worked out by Mr. J. A. C. Branfill, will prove useful in many branches of photography, especially where several lenses of varying foci are in constant use for a variety of purposes :—

Let p = Principal focus.
F = Greater conjugate do.
f = Lesser do. do.
$D = F + f$ = distance of image from object.
r = Ratio of any dimension in original to the same dimension in copy (in case of reduction), or *vice versâ* (in case of enlargement).
a = Effective diameter of diaphragm.
U. S. No. = 'Uniform System' No. of do.
x = Comparative exposure required.

Then

$$p = D \times \frac{r}{(r+1)^2} = \frac{Ff}{D} = \frac{F}{r+1} = \frac{rf}{r+1}$$

$$F = p\,(r+1) = \frac{pf}{f-p} = rf = \frac{rD}{r+1}$$

$$f = p \times \frac{(r+1)}{r} = \frac{pF}{F-p} = \frac{D}{r+1} = \frac{F}{r}$$

$$D = p \times \frac{(r+1)^2}{r} = f\,(r+1) = p\left(2 + r + \frac{1}{r}\right)$$

$$r = \frac{F-p}{p} = \frac{p}{f-p} = \frac{F}{f}$$

$$\text{U. S. No.} = \frac{p^2}{16\,a^2}$$

$$x = \frac{f^2}{16\,a^2} = \frac{p^2}{16\,a^2} \times \frac{(r+1)^2}{r^2}$$

N.B.—For ordinary landscape work, where r is greater than 20, x may be taken as $\frac{p^2}{16\,a^2}$

Note.—In case the above may not be clear to some photographers, the following rules may be better understood :—

To find the principal focus of a lens (p), focus a near object in the camera, and measure the distance between it and the ground-glass (D) ; next find the proportion which any dimension in the object bears to the same dimension on the ground-glass (r). Thus, if the original dimension be four times as large as its reproduction, we say that r equals (=) 4. Multiply D by r, and divide the product by the square of a number greater by one than r, or $(r + 1)^2$. This rule was lately published by Mr. Debenham.

To find the lesser conjugate focus (f) (if p and r are known) multiply p by the sum of $r + 1$ and divide the product by r. Or divide D by $r \pm 1$.

To find the greater conjugate focus (F) multiply p by $r \pm 1$. Or multiply f by r.

To find D (the distance which the ground-glass should be from the object to be copied in order to get a given value for r) multiply p by the sum of $r \pm \frac{1}{r} \pm 2$.

To find r divide $F - p$ (the difference between F and p) by p. Or divide p by $f - p$. Or divide F by f.

To find x divide the square of f by 16 times the square of a (the diameter of aperture to lens).

For example : focus an object which is five inches high, so that it is one inch high on the ground glass ; thus we know that $r = 5$. Next measure the distance between the object and the ground glass (D), which is found to be 45 inches.

Then $p = 45 \times$ (multiplied by) $5 \div$ (divided by) $6 \times 6 = 6\frac{1}{4}$ inches.
$f = 6\frac{1}{4} \times 6 \div 5 = 7\frac{1}{2}$ inches. Or $f = 45 \div 6 = 7\frac{1}{2}$ inches.
$F = 6\frac{1}{4} \times 6 = 37\frac{1}{2}$ inches. Or $F = 7\frac{1}{2} \times 5 = 37\frac{1}{2}$ inches.
$D = 6\frac{1}{4} \times (5 + \frac{1}{5} + 2) = 6\frac{1}{4} \times 7\frac{1}{5} = 45$ inches.
$r = (37\frac{1}{2} - 6\frac{1}{4}) \div 6\frac{1}{4} = 5$. Or $r = 6\frac{1}{4} \div (7\frac{1}{2} - 6\frac{1}{4}) = 5$.

MR. E. M. NELSON'S TABLE OF DISTANCES FOR LANTERN PROJECTION.

DISTANCE OF PROJECTION LENS FROM SCREEN, MASK BEING THREE INCHES.

Foci	4½		5		5½		6		7		8		9		10		11		12	14		15		16		18	
Disc.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
5	7	10½	8	9	9	7½	10	6	12	3	14	0	15	9	17	6	19	3	21	24	6	26	3	28	0	31	6
6	9	4½	10	5	11	5½	12	6	14	7	16	8	18	9	20	10	22	11	25	29	2	31	3	33	4	37	6
7	10	10½	12	1	13	3½	14	6	16	11	19	4	21	9	24	2	26	7	29	33	10	36	3	38	8	43	6
8	12	4½	13	9	15	1½	16	6	19	3	22	0	24	9	27	6	30	3	33	38	6	41	3	44	0	49	6
9	13	10½	15	5	16	11½	18	6	21	7	24	8	27	9	30	10	33	11	37	43	2	46	3	49	4	55	6
10	15	4½	17	1	18	9½	20	6	23	11	27	4	30	9	34	2	37	7	41	47	10	51	3	54	8	61	6
11	16	10½	18	9	20	7½	22	6	26	3	30	0	33	9	37	6	41	3	45	52	6	56	3	60	0	67	6
12	18	4½	20	5	22	5½	24	6	28	7	32	8	36	9	40	10	44	11	49	57	2	61	3	65	4	73	6
13	19	10½	22	1	24	3½	26	6	30	11	35	4	39	9	44	2	48	7	53	61	10	66	3	70	8	79	6
14	21	4½	23	9	26	1½	28	6	33	3	38	0	42	9	47	6	52	3	57	66	6	71	3	76	0	85	6
15	22	10½	25	5	27	11½	30	6	35	7	40	8	45	9	50	10	55	11	61	71	2	76	3	81	4	91	6
16	24	4½	27	1	29	9½	32	6	37	11	43	4	48	9	54	2	59	7	65	75	10	81	3	86	8	97	6
18	27	4½	30	5	33	5½	36	6	42	7	48	8	54	9	60	10	66	11	73	85	2	91	3	97	4	109	6
20	30	4½	33	9	37	1½	40	6	47	3	54	0	60	9	67	6	74	3	81	94	6	101	3	108	0	121	6
25	37	10½	42	1	46	3½	50	6	58	11	67	4	75	9	84	2	92	7	101	117	10	126	3	134	8	151	6
30	45	4½	50	5	55	5½	60	6	70	7	80	8	90	9	100	10	110	11	121	141	2	151	3	161	4	181	6
35	52	10½	58	9	64	7½	70	6	82	3	94	0	105	0	117	6	129	3	141	164	6	176	3	188	0	211	6
40	60	4½	67	1	73	9½	80	6	93	11	107	4	120	9	134	2	147	7	161	187	10	201	3	214	8	241	6
45	67	10½	75	5	82	11½	90	6	105	7	120	8	135	9	150	10	165	11	181	211	2	226	3	241	4	271	6
50	75	4½	83	9	92	1½	100	6	117	3	134	0	150	9	167	6	184	3	201	234	6	251	3	268	0	301	6

TABLE OF DISTANCES FOR AN OBJECT OF SIXTY-EIGHT INCHES HEIGHT.

Computed by P. Brosig.

Equivalent Focus (inches).	Heights of Images (inches).																	
	1	2	3	4	6	8	10	12	14	16	20	24	28	32	40	48	56	68
2	138·0 2·0	70·0 2·1	47.3 2·1	36·0 2·1														
3	207·0 3·0	105·0 3·1	71·0 3·1	54·0 3·2	37·0 3·3													
4	276·0 4·1	140·0 4·1	94·7 4·2	72·0 4·2	49·3 4·4	38·0 4·5												
5	345·0 5·1	175·0 5·1	118·3 5·2	90·0 5·3	61·7 5·4	47·5 5·6	39·0 5·7											
6	414·0 6·1	210·0 6·2	142·0 6·3	108·0 6·4	74·0 6·5	57·0 6·7	46·8 6·9	40·0 7·1	35·1 7·2									
7	483·0 7·1	245·0 7·2	165·7 7·3	126·0 7·4	86·3 7·6	66·5 7·8	54·6 8·0	46·7 8·2	41·0 8·4	36·7 8·6								
8	552·0 8·1	280·0 8·2	189·3 8·4	144·0 8·5	98·7 8·7	76·0 8·9	62·4 9·2	53·3 9·4	46·9 9·6	42·0 9·9	35·2 10·4							
9	621·0 9·1	315·0 9·3	213·0 9·4	162·0 9·5	111·0 9·8	85·5 10·1	70·2 10·3	60·0 10·6	52·7 10·9	47·2 11·1	39·6 11·6							
10	690·0 10·1	350·0 10·3	236·7 10·4	180·0 10·6	123·3 10·9	95·0 11·2	78·0 11·5	66·7 11·8	58·6 12·1	52·5 12·4	44·0 12·9	38·3 13·5	34·3 14·1					
11	759·0 11·2	385·0 11·3	260·3 11·5	198·0 11·6	135·7 12·0	104·5 12·3	85·8 12·6	73·3 12·9	64·4 13·3	57·7 13·6	48·4 14·2	42·2 14·9	37·7 15·5	34·4 16·2				
12	828·0 12·2	420·0 12·4	284 0 12·5	216·0 12·7	148·0 13·1	114·0 13·4	93·6 13·8	80·0 14·1	70·3 14·5	63·0 14·8	52·8 15·5	46·0 16·2	41·1 16·9	37·5 17 6				
13	897·0 13·2	455·0 13·4	307·7 13·6	234·0 13·8	160·3 14·1	123·5 14·5	101·4 14·9	86·7 15·3	76·1 15·7	68·2 16·1	57·2 16·8	49·8 17·6	44·6 18·4	40·6 19·1	35·1 20·6			

Values are omitted in this space on account of the wide angle of lens required. (More than ninety degrees.)

14	966·0 14·2	490·0 14·4	331·3 14·6	252·0 14·8	172·7 15·2	133·0 15·6	109·2 16·1	93·3 16·5	82·0 16·9	73·5 17·3	61·6 18·0	53·7 18·9	48·0 19·8	43·7 20·6	37·8 22·2			
16	1104 16·2	560·0 16·5	378·7 16·7	288·0 16·9	197·3 17·4	152·0 17·9	124·8 18·4	106·7 18·8	93·7 19·3	84·0 19·8	70·4 20·7	61·3 21·6	54·9 22·6	50·0 23·5	43·2 25·4	38·7 27·3	35·4 29·2	—
18	1242 18·3	630·0 18·5	426·0 18·8	324·0 19·1	222·0 19·6	171·0 20·1	140·4 20·6	120·0 21·2	105·4 21·7	94·5 22·2	79·2 23·3	69·0 24·4	61·7 25·4	56·2 26·5	48·6 28·6	43·5 30·7	39·9 32·8	36·0 36·0
20	1380 20·3	700·0 20·6	473·3 20·9	360·0 21·2	246·7 21·8	190·0 22·4	156·0 22·9	133·3 23·5	117·1 24·1	105·0 24·7	88·0 25·9	76·7 27·1	68·6 28·2	62·5 29·4	54·0 31·8	48·3 34·1	44·3 36·5	40·0 40·0
22	1518 22·3	770·0 22·6	520·7 23·0	396·0 23·3	271·3 23·9	209·0 24·6	171·6 25·2	146·7 25·9	128·9 26·5	115·5 27·2	96·8 28·5	84·3 29·8	75·4 31·1	68·7 32·4	59·4 34·9	53·2 37·5	48·7 40·1	44·0 44·0
24	1656 24·4	840·0 24·7	568·0 25·1	432·0 25·4	296·0 26·1	228·0 26·8	187·2 27·5	160·0 28·2	140·6 28·9	126·0 29·6	105·6 31·1	92·0 32·5	82·3 33·9	75·0 35·3	64·8 38·1	58·0 40·9	53·1 43·8	48·0 48·0
26	1794 26·4	910·0 26·8	615·3 27·1	468·0 27·5	320·6 28·3	247·0 29·0	202·8 29·8	173·3 30·6	152·3 31·3	136·5 32·1	114·4 33·6	99·7 35·2	89·1 36·7	81·2 38·2	70·2 41·3	62·8 44·4	57·6 47·4	52·0 52·0
28	1932 28·4	980·0 28·8	662·7 29·2	504·0 29·6	345·3 30·5	266·0 31·3	218·4 32·1	186·7 32·9	164·0 33·8	147·0 34·6	123·2 36·2	107·3 37·9	96·0 39·5	87·5 41·2	75·6 44·5	67·7 47·8	62·0 51·1	56·0 56·0
32	2208 32·5	1120 32·9	757·3 33·4	576·0 33·9	394·7 34·8	304·0 35·8	249·6 36·7	213·3 37·6	187·4 38·6	168·0 39·5	140·8 41·4	122·7 43·3	109·7 45·2	100·0 47·1	86·4 50·8	77·3 54·6	70·9 58·4	64·0 64·0
36	2484 36·5	1260 37·1	852·0 37·6	648·0 38·1	444·0 39·2	342·0 40·2	280·8 41·3	240·0 42·4	210·9 43·4	189·0 44·5	158·4 46·6	138·0 48·7	123·4 50·8	112·5 52·9	97·2 57·2	87·0 61·4	79·7 65·6	72·0 72·0
44	3036 44·6	1540 45·3	1041 45·9	792·0 46·6	542·7 47·9	418·0 49·2	343·2 50·5	293·3 51·8	257·7 53·1	231·0 54·3	193·6 56·9	168·7 59·6	150·9 62·1	137·5 64·7	118·8 69·9	106·3 75·1	97·4 80·2	88·0 88·0
52	3588 52·8	1820 53·5	1231 54·3	936·0 55·1	641·3 56·6	494·0 58·1	405·6 59·6	346·7 61·2	304·6 62·7	273·0 64·2	228·8 67·3	199·3 70·4	178·3 73·4	162·5 76·5	140·4 82·6	125·7 88·7	115·1 94·8	104·0 104·0

This table gives, in inches, the distances from lens to object (greater conjugate focus, upper number) and from lens to ground glass (lesser conjugate focus, lower number) for different heights of images and different lengths of foci of lenses, when the height of object is 68 inches (=average height of man).

EXAMPLES.

Q.—What is the height of image of a person who is 133 inches distant from lens, when a lens of 14 inches focus is used?

A.—The height of image in this case is 8 inches.

Q.—What are the distances between object, lens, and ground glass if the image of a person is to be 8 inches high and a 14 inches focus lens is employed?

A.—The distance from object to lens will be 133 inches, from lens to ground glass 15·6 inches.

TABLES OF DISTANCES AT AND BEYOND WHICH ALL OBJECTS ARE IN FOCUS.

SIR D. SALOMON'S TABLE.

Focus of Lens in inches.	Ratios marked on Stops.													
	f/7	*f*/8	*f*/9	*f*/10	*f*/11	*f*/12	*f*/13	*f*/14	*f*/15	*f*/16	*f*/17	*f*/18	*f*/19	*f*/20
	Number of feet after which all is in focus.													
4	19	17	15	14	13	12	11	10	9	9	8	8	7	7
4¼	21	19	17	15	14	12	11	11	10	10	9	9	8	7
4½	25	22	19	17	16	15	13	13	12	11	10	10	9	9
4¾	27	23	21	19	18	16	15	14	13	12	12	11	10	10
5	30	27	24	21	19	18	17	15	14	14	13	12	11	10
5¼	33	29	25	23	21	20	18	17	16	15	14	13	13	12
5½	37	31	29	26	23	22	20	19	17	16	15	15	14	13
5¾	39	34	31	28	26	24	22	20	18	18	17	16	15	14
6	43	38	33	31	28	26	24	22	21	20	18	17	16	15
6¼	47	41	37	33	30	23	26	24	22	20	20	19	18	17
6½	50	45	40	36	33	29	28	26	24	23	21	20	19	18
6¾	55	48	43	39	36	32	30	28	25	24	22	22	21	20
7	58	52	45	42	38	35	31	30	28	26	25	23	22	21

DR. J. J. HIGGINS'S TABLE.

Equivalent Focus.	*f*/5	*f*/6	*f*/7	*f*/8	*f*/9	*f*/10	*f*/11	*f*/12	*f*/13	*f*/14	*f*/15
5 inches	42	35	30	26	23	21	19	17½	16	15	14
5½ ,,	50½	42	36	32	28	25	23	21	19	18	17
6 ,,	60	50	43	38	34	30	27	25	23	21	20
6½ ,,	70½	59	50	44	39	35	32	29½	27	25	23½
7 ,,	82	68	59	51	45	41	39	34	31	29½	27

Calculated for a Confusion Disc of less than $\frac{1}{100}$ of an inch.

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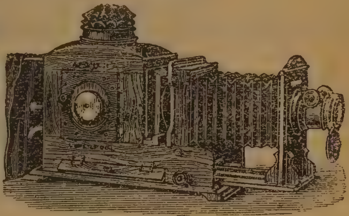

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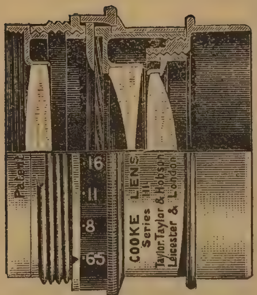

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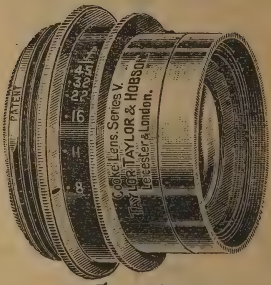

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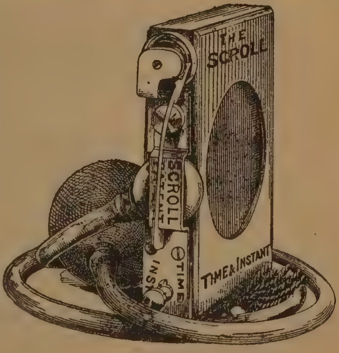

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